1657

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LXXXVI

MARCH to JUNE, 1911

" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

RICHARD CLAY & SONS, LTD.,
BRUNSWICK STREET, STAMFORD STREET, S.E.,
AND BUNGAY, SUFFOLK.

INDEX.

Reviews and Our Bookshelf.

RICHARD CLAY & SONS, LTD.,
BRUNSWICK STREET, STAMFORD STREET, S.E.,
AND BUNGAY, SUFFOLK.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MARCH 2, 1911.

RESEARCHES ON RADIOACTIVITY.

Traité de Radioactivité. By Prof. Mme. P. Curie. Tome i., pp. xiii+426. Tome ii., pp. 548. (Paris: Gauthier-Villars, 1910.) Price, 2 vols., 30 francs.

NO more effective illustration of the rapidity of advance of accurate knowledge of radioactivity can be taken than a comparison of the two books published on the subject by Mme. Curie, at an interval of seven years. The first, published as a thesis for the doctorate of science in 1903, was a small volume of 142 pages, and gave an account, not only of her own work, but of most of the important facts known in radio-activity at that time. The second, published at the close of 1910, consists of two volumes, containing in all nearly a thousand closely-written pages, and giving an orderly and systematic account of the large mass of data that has been accumulated in the interval. The remarkable rapidity of advance of this new branch of science largely results from two factors—the discovery and isolation of radium by Prof. and Mme. Curie, and the development of the transformation theory in 1903.

The discovery of radium gave an opportunity to the investigator of obtaining intensely radio-active material, in which the typical radio-active effects are shown on a very marked scale. The remarkable properties of radium attracted the attention of the scientific world, and gave a great impetus to the study of radio-activity. On the other hand, the transformation theory has proved an invaluable guide to the investigator in disentangling the apparently complicated processes occurring in radio-active matter. It offers a rational explanation of practically all the experimental facts that have been discovered, and has been instrumental in bringing to light a number of unsuspected relations of great importance.

This work represents, with additions, the course of lectures on radio-activity given by Mme. Curie in the Sorbonne. The first chapter is devoted to an account of the conduction of electricity through gases, and the second to a description of the methods employed in radio-active measurements. The latter contains a somewhat detailed account of the theory of the electrometer and of the quartz piezo-electrique devised by J. and P. Curie. Chapters iii. and iv. include an account of the general radio-active properties of uranium and thorium, and of radio-active minerals, and a very complete account of the methods of isolation of radium and polonium and other radio-active materials. This chapter will be read with especial interest, as it is largely an account of the author's well-known discoveries. The next three chapters deal with the radio-active properties of the emanations, and of the active deposits which are derived from them. A very full description is given of the methods employed in determining the molecular weight of the emanation by diffusion methods, and also a clear account of recent work upon the purification of the radium emanation, the determination of its volume, and of its physical and chemical properties. In chapter viii., after a review of the various theories proposed, the transformation theory is adopted, and the mathematical theory of successive transformations is given. Then follows a long chapter of more than 200 pages, giving a systematic account of the nature of the radiations from radio-active bodies, followed by a discussion of the general physical and chemical effects shown by the radiations, including the production of helium from radio-active matter, and an account of the experiments which have been made by Ramsay and others to test whether the radiations from active matter are able to transform inactive elements. After a discussion of the various experiments, Mme. Curie sums up as follows:—

> "En résumé, on peut considérer qu'il n'y a pas encore actuellement de raisons suffisantes pour admettre que la formation de certains éléments puisse être provoquée à volonté en présence de corps radioactifs. La production d'hélium reste acquise; mais elle est reliée à une propriété essentielle des éléments radioactifs et n'est pas influencée par l'intervention de l'expérimentateur."

Chapter xi. gives an account of the methods of measurement of heat emission of the radio-active substances, while the next four chapters deal with suc-

cessive transformations occurring in uranium, thorium, radium, and actinium, followed by an account of the origin of radium and the discovery of ionium, and the discussion of the general connection between the radio-active series. The last chapter is devoted to a consideration of the radio-activity of the earth and atmosphere.

An excellent portrait of Pierre Curie is given in the frontispiece. Several interesting reproductions are included at the end of the volume in illustration of the photographic effects of the various radiations. Carefully prepared tables are included in the text, giving the important radio-active constants, while a table of exponential values is added for convenience in calculating the decay and growth of the radium emanation.

In these two volumes, written in a clear and interesting manner, Mme. Curie gives a full and complete account of practically all the work of importance that has been done in radio-activity. It is a storehouse of accurate information. The author has shown judgment in the selection of data and in discussion of points at issue. The chemical methods of separation of radio-active products are in most cases briefly given, while a detailed account is included of the methods of separation of radium and of polonium. This is excellent so far as it goes, but it does not fill the pressing need at the present time of a practical book on the methods of separation and purification of the numerous radio-active products. Such an account should prove of the greatest value both to chemists and physicists, for it is becoming more and more important in many lines of work that the investigator should be able to separate and concentrate the various radio-active products. Such an account can only be written by an expert both on the physical and chemical side who has himself worked over the subject, for more than a compilation of chemical methods is required.

It is always a difficult matter in a work of this character, which treats of a rapidly growing subject, to give full credit to pioneer discoveries, and at the same time to do justice to later work of a more detailed and accurate character. Mme. Curie has, to a large extent, overcome this difficulty by giving a fairly detailed account of the original experiments, and a more condensed statement of subsequent work.

There is very little to criticise and much to admire in this notable work. It is remarkable what little difference of opinion exists among radio-active workers on the interpretation of the main phenomena. This is no doubt mainly a result of the general adoption of the theory of atomic disintegration, for on this theory only one explanation is in most cases admissible. While there is a general agreement on the fundamental points, there is naturally room for wide difference of opinion on matters still under investigation. This is well illustrated by the conflicting views that are at present held on the difficult question of the nature of the emission and of the absorption of the β and γ rays by active matter. The advocacy of rival views on such questions is in many cases a great advantage, for it gives an incentive to a more accurate and complete investigation of the problem under consideration.

While the reviewer finds that he is in substantial agreement with all the main conclusions of Mme. Curie, there are a few minor points to which attention may be directed. Mme. Curie includes radio-uranium as a possible product of uranium, although a note of interrogation is attached. She certainly makes a better case for its existence than is given in the original publication; but until more definite information is forthcoming it does not appear desirable to include it in the uranium series. The products radium E_1 and radium E_2 are retained, although later work of Antonoff has indicated conclusively that only one product of period about five days which emits β rays can be present. The discovery of ionium is credited to Rutherford and Boltwood; it should be Boltwood. The original suggestion that lead is a final product of the transformation of radium is attributed to Rutherford. It should be Boltwood. The term "radio-active induite" is used widely throughout the work. While the use of this expression is historically justified, it is a misnomer, especially when used in reference to radio-active *matter* deposited from the emanation. The term "active deposit," which has come into general use, is a very convenient substitute, and it is desirable that the original names, "induced," or "excited," activity, should disappear from the literature.

The lack of a name- or subject-index is a serious drawback to the usefulness of this treatise. The references to literature are incomplete, the name of the journal and the year of publication alone being given.

As an account of a youthful branch of science, the present treatise may appear somewhat lengthy; but it must not be forgotten that the subject of radio-activity now covers a very wide field of work. It has to treat, not only of the nature of remarkable types of radiation which are emitted, but also of the origin and physical and chemical properties of more than a score of new transition elements. In addition, it has to deal with the distribution of radio-active matter in the earth and atmosphere, and its bearing on atmospheric electricity and on problems connected with geology. Unless this treatise is to become unwieldy in size, it will be necessary in future editions, where much new work has to be included, to adopt a policy of more rigid selection and compression of the experimental data to be discussed. No doubt as our knowledge of the various questions becomes more definite, it will not be so difficult as at present to give a complete review of theory and experiment within reasonable limits of space.

The present work will be read with the greatest interest by all workers in radio-activity as an authoritative account of the subject from one who has made notable contributions to its history. The book is essentially written for the investigator rather than for the ordinary student, and will be of the greatest service to the former as a complete and accurate review of all important publications on the subject. Every reader will recognise the great labour and patience involved in writing a complete treatise on such a rapidly growing subject, and Mme. Curie is to be congratulated on the success of her efforts.

This treatise is a noteworthy contribution to the

literature of this new and fascinating field of scientific inquiry, and redounds to the credit of Mme. Curie, and to the nation which has taken such a fundamental and prominent part in the development of radioactivity.

E. R.

DYNAMO-ELECTRIC MACHINERY.

The Dynamo: Its Theory, Design, and Manufacture. By C. C. Hawkins and F. Wallis. Fifth edition. Re-written, revised, and enlarged. Vol i., pp. x+542. Vol. ii., pp. viii+543–1134. (London: Whittaker and Co., 1909.) Price 21s. net, two vols.

THE increase in the size of Messrs. Hawkins and Wallis's book is a good indication of the progress that has taken place in the practical development of the dynamo. Little or no addition has been made in the interval to the fundamental theory of direct-current and alternating machines; an immense advance has been made in the mastery of the thousand and one details of selection of materials and methods of construction of machines for different purposes.

Vol. i. is mainly theoretical, and contains statements regarding the physical facts and theories on which electric generators and motors are based. The treatment of the magnetic circuit, of self-induction and alternating currents, the classification of dynamos, the magnetic properties of iron, and so forth, strike one as exceedingly satisfactory. In general there is a clear perception of what constitutes a proof of a theorem and what a mere illustration or representation of results. It is possible to frame graphical proofs of theorems of electromagnetism, as of dynamical theorems regarding stresses in the members of a girder, and it is a good thing to do so; but many so-called graphical "proofs" are mere illustrations of results which have been so far only satisfactorily established by analysis. The graphical representation displays to the eye connections of things set forth in equations, and so far as possible this should be done in all departments of mathematical physics; but the student should not be led to imagine that he has got to the root of the matter, when he realises that $\sqrt{R^2+n^2L^2}$ is the length of the hypotenuse of a right-angled triangle, the lengths of the sides of which are R and nL. As it seems to us, Messrs. Hawkins and Wallis have given a very happily blended analytical and geometrical discussion.

The analogy of inductance and capacity to inertia and the slackness of a buffer spring, of the electrokinetic energy $\frac{1}{2}Li^2$ to the kinetic energy of a carriage, and the analogy of the dissipation of this kinetic energy, when the carriage is brought to rest by collision with the buffers, to the break of a circuit containing a condenser, gives a clearer idea of what happens than general statements, and we should have liked to see some such practical "engineering" illustrations in the chapter on self-induction.

Then it is a little difficult to distinguish, as the authors seem to do on p. 69, between "the current itself," and the magnetic field which it produces. Is it not all one phenomenon? One may try to distinguish between the current—the motion of electrons (or, as someone has illuminatingly called them, the essential singularities that are at the root of all electrical action)—and the magnetic field, but is it possible to do so really? One cannot have a vortex filament in an infinite fluid without the irrotational flow which constitutes its field. It may be said that by twisting the outward and inward wires of a circuit together or by putting one inside the other, a field can be avoided; but the assertion is only true for space external to the conductors. A field can only be avoided altogether by making the going and returning conductors absolutely coincident, in which case there is no current.

The molecular theory of magnetism may possibly require modification in view of still more modern theories of the electrical constitution of matter; but it has done much service in clarifying the ideas of students of magnetism, and it still substantially fits the facts. How often did one find in elementary books the higgledy-piggledy arrangement of molecular magnets pictured, to explain to the reader the constitution of a body in the neutral state? It never seemed to occur to the writers that these magnetic molecules must act on one another, and that the perfectly fortuitous arrangement was unlikely to have been set up, or to remain if it were. The closed chains were in the minds of many; the exhibition of Ewing's model made clear how these closed chains led to the observed magnetisation curves.

During the last year or two much further work on magnetic induction in iron and alloys has been done, and on the influence of treatment of different kinds: it will be for the dynamo builder and user to examine whether any part of the work is likely to be of use to them. But no doubt for a long time the knowledge that has been accumulated of the constants of steel of different kinds, in stampings of different thicknesses, will be sufficient for their needs.

Chapters xiv. and xv. of the first volume, on "Field-Magnets" and "The Ampere-Turns of the Field" respectively, are exceedingly instructive and interesting, and are, of course, of great importance, for the proper design of a dynamo or motor for a given specified purpose depends entirely on a due appreciation of the principles laid down in every sound discussion of this subject.

In vol. ii., after a discussion of armature reaction which seems adequate, a long chapter (110 pages) is given on "Commutation and Sparking at the Brushes." This important subject is very fully dealt with, apparently with a thorough appreciation of all that has been done on the subject of commutation and the factors on which sparking at the brushes depends, and also of the quantitative laws of the matter so far as these have been theoretically and empirically compiled.

Chapters follow on the "Design of Continuous-Current Dynamos and Alternators," and these are based on a full description of all the various forms of armatures and field-magnets in use in the various types.

The book, if a little heavy (in avoirdupois), is beautifully printed and magnificently illustrated with 594 pictures, diagrams, and cuts of different sorts, and reflects credit on authors and publishers alike.

A. G.

RÖMER'S ADVERSARIA.

Ole Römer's Adversaria, med Understöttelse af Carlsbergfondet udgivne af det Kgl. Danske Videnskabernes Selskab. By Thyra Eibe and Kirstine Meyer. Pp. v+271. (Köbenhavn: Bianco Lunos Bogtrykkeri, 1910.)

AMONG astronomers Ole Römer (1644–1710) occupies a peculiar position. He was held in high repute among contemporary men of science, as may be seen from the fact that Newton and he were the first astronomers to be enrolled among the eight foreign associates of the Paris Academy of Sciences, and were elected on the same day. To posterity he is known as the discoverer of the gradual propagation of light, and as the man who introduced the use of (if he did not invent) the transit instrument and the transit circle. And yet his published writings only fill a few pages, and the observations he made with instruments far superior in design to those of his time, were not printed, and nearly all of them perished not long after his death. There is, therefore, every reason to welcome the publication of his common-place book, which has been brought out just two hundred years after his death.

Like every other book of its kind, the present book of Adversaria deals in a scrappy way with a great variety of subjects, and it shows what chiefly occupied Römer's mind, especially during the last ten years of his life. We see him as a practical astronomer, as a physicist, and as a man who had for many years served his country well by reorganising the system of weights and measures, getting the Gregorian calendar introduced, and preparing a uniform system of land taxation. But though these various occupations, which gradually came to fill most of his time to the great loss of science, are now and then alluded to in the present volume, they do not fill many pages in it. It looks as if Römer was in the habit of taking refuge in his commonplace book when he wanted to refresh his mind after his hard work as Burgomaster and Chief of Police of Copenhagen. To give a full account of the contents of his notes is not possible in a limited space: we can only give the reader some idea of the kind of subjects dealt with. An important section on thermometers, dating from 1702, has already been described in NATURE, (vol. lxxxii., p. 296). Römer appears to have been the first to construct thermometers with two fixed points, marking the temperatures of melting snow and of boiling water, and he was the inventor of the scale known as Fahrenheit's.

Turning to astronomical matters, we find Römer to have been a follower of Descartes in his views on the construction of the universe, though his own discovery about light did not exactly harmonise with Cartesian ideas. He inquires at what distance a planet or satellite would have to be from the central body according to the third law of Kepler in order that its period of revolution may equal the period of rotation of the central body. In the case of a planet he finds the distance equal to 37 semidiameters of the sun, in the case of a satellite of the earth $6\frac{1}{2}$, and for a satellite of Jupiter 2 semidiameters of the respective planet. This, he thinks, may be made to agree with the vortex theory by assuming that radiation from the central body impedes the rotation of the ether, and this radiation, being naturally much more powerful from the sun, causes its influence to be felt at a much greater distance than that at which the radiation of a planet is perceptible. He shows himself interested in solar phenomena by calculating the apparent position of the sun's axis, and of the path of sun-spots for every $7\frac{1}{2}°$ of longitude of the sun, having first determined the inclination of the sun's equator and the place of the node with fair accuracy from his own and La Hire's observations. It will be remembered that the sun's equator was in those days often used as a fundamental plane or Via Regia of the solar system. He calculates the transit of Mercury of May, 1707, from Kepler's elements and observations by Hevelius of the transit of May, 1661. He calculates the solar eclipse of September 13, 1708, for Copenhagen, and Holum in Iceland, and gives rules for the prediction and graphic representation of an eclipse. The transit instrument in the prime vertical, of which he had introduced the use, is employed for the determination of the vernal equinox of 1702, and he examines the consequences of errors of observation in the transit, and shows how to determine the error of collimation by reversing the instrument.

The above examples, which could easily be multiplied, will show that the two ladies who have edited this book have done good work by bringing it to light. There is a useful index and an excellent table of contents, and every care seems to have been taken to produce an accurate edition of the old manuscript. The few Danish words or sentences occurring here and there might have been translated in foot-notes for the convenience of readers not acquainted with that language.

J. L. E. D.

GALL-FLIES AND OTHERS.

Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Edited by F. E. Schulze. 24 Lieferung. Hymenoptera. Cynipidæ. By Prof. K. W. von Dalla Torre and Prof. J. J. Kieffer. Pp. xxxv+891. (Berlin: R. Friedlander and Son, 1910.) Price 56 marks.

THIS work forms a worthy volume of the series of zoological works published under the general title of "Das Tierreich," by Messrs. R. Friedlander and Son, of Berlin. It is an extension of the two volumes by Dr. Kieffer in André's "Species des Hyménoptères d'Europe et de l'Algérie." Dealing as it does with the Cynipidæ of the whole world, and containing descriptions of all the known genera and species, the book is indispensable to students of the Cynipidæ. Theodore Hartig was the pioneer of the scientific study of the group. He placed the classification on a proper basis, and was the first to point out the threefold habits of the species—gall-makers, inquilines, and parasites. After him came Giraud, Schenk, and, above all, G. L. Mayr, who made the identification of the galls easy by the publication of beautifully illustrated works on the species of Central Europe, as well as a monograph on the guest-flies (Synergi).

Then came the epoch-making discovery by Dr. Adler of the existence of alternations of generation—that a spring bisexual form was followed by an autumnal unisexual one, the two forms having totally different galls.

The volume commences with a list of the authors who have published separate works, and of the titles of the journals and transactions of scientific societies in which papers have appeared, the total number being 252, beginning with Malpighi in 1675. The titles of papers in magazines and transactions are not given. If they had we should have had the names of T. A. Marshall, E. A. Fitch, Prof. J. W. H. Trail, and other workers at British cecidology, besides the seven British authors given in the catalogue. We notice that while the list contains the French translation of Adler's papers, no mention is made of the English one by Mr. Standen. Next we have a "systematic index" of the genera and species, followed by the descriptions of the subfamilies, genera, and species, the whole concluding with a good index of the genera and species, but not of the plants, and a "Nomenclator generum et sub-generum." There are no figures of entire insects, but there are some illustrating the structure in the introduction, while there are 398 wood-cut illustrations of galls.

The authors divide the family into ten subfamilies and 126 genera, besides two doubtful ones; describe fully 1281 species, as well as 102 subspecies; in addition there are 212 species which have been too briefly described for recognition, and of which the original descriptions are reprinted. Some changes in generic nomenclature are made. Allotria, West., and Xystus, Htg., its synonym, are suppressed, both being preoccupied. In place of them Dr. Kieffer adopts Charips, a MS. name of Haliday, first used by Marshall. The name of Diplolepis is revived after long disuse, it replacing Dryophanta. On the other hand Ashmead considers it to be the same as Diastrophus. The system of subgeneric names and trinomials for the species with well-marked varieties is adopted. Thus we have Eucœla and Cothonaspis, both with nine subgenera, the latter being genera with Foerster and Ashmead. This method, in some cases, leads to a species having four names, *e.g.* we have *Eucoila Psichacra Marshalli Marshalli* for the typical form of Cameron's species, and *Eucoila Psichacra Marshalli rufo-notata* for the variety.

An interesting fact in the biology of the parasitic Cynipidæ is that some species are found in ants' nests. Long ago Westwood bred *Charips victrix* from the rose aphis, and as many other species of the same genus have also been bred from plant-lice, it might fairly be concluded that the genus was a beneficial one. There is now, however, reason to believe that Charips is a hyperparasite, destroying, not the aphis, but the beneficial Braconid which preys on it. If that is so the species must be looked upon as injurious. The present writer has seen *Charips victrix* ovipositing in plant-lice killed by Aphidius, which pupates in the lice, the bodies of which become dried, inflated, and are attached to the leaf by the parasites. *Cothonaspis zig-zag* is another injurious hyperparasite, it destroying *Phora aeletiae*, the parasite of the injurious cutworm of the cotton. Among the habitats of the Parasitica is the sea-shore, where two British semiapterous species are found at high-water among seaweed.

It is curious how the Cynipidæ form their galls on certain plants more than on others. The oak in Europe and in North America is the predominant food-plant. In Europe *Quercus pedunculata* harbours ninety-nine species, *Q. pubescens* seventy-nine, and *Q. sessiliflora* ninety-six. After the oak come the Rosaceæ—Rosa, Rubus, Potentilla. The poppy has two species in the fruit and one in the stem. It is remarkable that the willows, on which there are so many dipterous and saw-fly galls, have not one species of Cynipidæ attached to them.

As regards the distribution, Dr. Kieffer gives some curious examples of the unequal manner in which some genera are distributed in Europe and North America. Callirhytis has four species in Europe, in America fifty-two. Rhodites has twelve Palæarctic and seventeen Nearctic, while Lytorhodites is exclusively Nearctic, as is also Amblybolyps with twenty-four species. A few species are found in Europe and North America, *e.g.* our "begeguar" and *Aulax latreillei* on *Glechoma hederacea* as in Europe, while *Rhodites eglanteriae* is recorded from the West Indies. Solanum should be deleted from the list of food-plants, it being now known that the galls of *Tribalia batatorum* came from the rose and not from the potato. Ashmead is no doubt correct in considering Tribalia to be identical with Lytorhodites.

There are one or two points in the work which concern our British species—Aulax, Hartig, is split up into two—Aulax (Kieffer retains the old, incorrect spelling, Aylax) with *latreillei*, Kief. (*glechomae* of Cameron's monograph), *hypochoeridis*, *papaveris*, *minor*, *scabiosae*, and *Fitchi*; and Aulacidea with *hieracii* and *graminis*. We doubt if *Cynips kollari*, our common "marble gall" fly, is dimorphic, and that *Andricus circulans* (a Turkey-oak species found in Britain only in Kew Gardens) is its sexual form. Our own experiments appear to show that it is agamic, while, if *A. circulans* were its sexual form, it surely should be equally common and as widely distributed.

In conclusion, we have to congratulate cecidologists on the appearance of this admirable and thorough work, which will be as useful to the beginner as to the advanced student in all parts of the world.

P. C.

THE CRYSTALLISATION MICROSCOPE.

Das Kristallisationsmikroskop und die damit gemachten entdeckungen insbesondere die der flüssigen Kristalle. By Prof. O. Lehmann. Pp. iv+112. (Braunschweig: F. Vieweg and Son, 1910.) Price 3 marks.

PROF. LEHMANN is gifted with the pen of a ready writer, and has in recent years poured forth such a voluminous stream of papers and books dealing with the subject of mobile crystals in its many aspects that considerable overlapping and repetition necessarily exists in them. Such criticism may be levied also against the present little book, which first

saw light in the pages of a *Festschrift,* issued by the Technische Hochschule in Carlsruhe, to commemorate the fifty-third birthday of the Grand Duke of Baden. It does, however, contain detailed descriptions of the latest forms of the microscope which have not appeared in print before, and would, moreover, be welcomed for the sake of the interesting historical account of Prof. Lehmann's researches, which spares the student of the subject the difficulty and trouble of hunting up a series of papers published at various dates and in various periodicals.

Nearly forty years have elapsed since Prof. Lehmann, while still a student, first devised a form of microscope by means of which substances could be observed at higher than ordinary room temperature, and the phenomenon of crystallisation watched in actual operation. The results of the research thereby rendered possible were, as is well known, unexpected and startling, and the meaning and even the reality of the observations were for long the subject of considerable discussion and dispute. Other workers have, however, in recent years entered the field, who on the whole have confirmed the accuracy of Prof. Lehmann's observations, and there can be no doubt but that the old ideas regarding crystals and crystallisation needed extensive modification. The investigations are discussed in chronological order in the present book, but since we noticed them less than two years ago (NATURE, 1909, vol. lxxix, p. 286), we shall not recur to them here. With each step some improvement in the instrument or some additional facility suggested itself until it reached the most recent form, which is provided with water jackets, powerful heating arrangement, means for reading the temperature, and a camera, and even a kinematograph, for giving a faithful record of the phenomena. The descriptions of the different forms are elucidated by excellent illustrations.

The last chapter of the book might with advantage have been omitted. Discussions of one's claim to priority of discovery, and the proper appraisement of one's work rarely serve a useful purpose, and are to be deprecated.

HEAT-ENGINES.

The Steam-Engine and other Heat-Engines. By Prof. J. A. Ewing, C.B., F.R.S. Third edition, revised and enlarged. Pp. xvii+604. (Cambridge: University Press, 1910.) Price 15*s.*

IN this, the third edition, Dr. Ewing has thoroughly revised his well-known text-book, and to some extent he has rewritten certain chapters; for example, the chapter on steam turbines is new, and the greater part of that devoted to gas and oil engines. The most important departure, however, is that in dealing with the properties of steam the author has accepted the characteristic equation of Callendar along with the steam tables derived from it by Mollier. The old steam tables were based chiefly on Regnault's well-known experiments, and it has been recognised that they involve inconsistencies and errors. Prof. Callendar, whose first paper on the subject was published in 1900, has devised a method of treatment which is free from inconsistencies, and gives, when expressed in the form of tables, results which agree with all the most recent experiments, at any rate, between the temperatures of 0° C. and 200° C. Possibly Callendar's equation will not give such a close approximation to experimental results for pressures lying beyond the upper of these two limits of temperature. In the form of an appendix, Dr. Ewing has added a brief account of Callendar's characteristic equation, and of Mollier's readjustment of the constants. Dr. Ewing has also decided to adopt the Centigrade scale throughout the whole of his book.

In chapter v., which is devoted to entropy, the author describes Dr. Mollier's graphic methods of representing the properties of steam. By the aid of these diagrams the engineer has placed at his disposal a simple method of solving the problem of determining the state of steam which is expanded adiabatically from any initial condition whether superheated or not, and of determining the greatest theoretical output obtainable from steam when the initial condition and the lower limit of temperature are assigned.

Chapter viii., on steam turbines, is an entirely new chapter, and will be found of great assistance by all engineers who are interested in the design and working of the steam turbine. The whole subject of the design of the steam turbine is fully discussed both from the theoretical and from the practical side.

The last chapter is a new one on gas and oil engines. The efficiency of the ideal cycle is worked out on the assumption of constant specific heat, and the author then discusses the problem of the variation of specific heat with temperature, or in other words, the relation between the internal energy of the gas and its temperature, and discusses the effect of this variation upon the efficiency of the ideal engine working on the ordinary gas engine cycle.

In its present form Dr. Ewing's book will undoubtedly be the text-book most frequently consulted by all engineers who have to deal with steam and other forms of heat engines. T. H. B.

GEOLOGICAL NATURE-STUDY.

The Earth and its Story. By Dr. A. R. Dwerryhouse. Pp. 364. (London: C. H. Kelly, n.d.) Price 5*s.* net.

THIS book has the same title, and covers the same ground, as one issued by Prof. A. Heilprin in 1896. What Heilprin did for young American readers, Dr. Dwerryhouse does, with even greater lucidity of expression, for beginners and unprofessional naturalists in the British Isles. His book is sent out by the publishers in good clear type, and is illustrated by photographs and maps printed in a brown tint on separate sheets of thick art paper. In this respect it has an advantage over all the elementary geological text-books that we know. Moreover, it is by no means a simple text-book. It is the work of a field-observer, who wishes to bring the results obtained by geologists home to any intelligent reader. Even fossil specimens are photographed, which gives them, for the author's purpose, a desirable air of reality, though the process will find less favour with

the student of generic forms. A coloured geological map of the British Isles is also included.

We have mentioned the illustrations at the outset, since the greater number are the work of the author, and he depends much on them in the physiographic portion of the book. Those of glacial phenomena seem especially excellent. May we, however, mildly protest once more at the translation of *roches moutonnées* as "sheep-back rocks" on p. 103?

The use of parts of British Ordnance maps to illustrate geographical features is in pleasant keeping with what has been done in recent text-books in America. But we venture to question whether a book of this kind should deal with geological history by means of a summary of stratigraphy as known to us in the British Isles. Would it not seem better to widen the view of the beginner by letting him know something of the great features of life-progress on the earth? The unconformities mentioned on p. 218 have no importance, except for the specialist in western Europe; nor are the names Lewisian and Torridonian at all comparable in value with those of the other systems classified in the table, which relate nowadays to no one special country. The real interest of the Carboniferous flora is not conveyed by the statements on p. 269; nor is the development of flowering plants fairly represented on p. 311, in view of discoveries outside our islands.

This introspective point of view, which has been impressed on us for fifty years by university curricula, forces the general reader to meet such things as Coniston Limestone, Blae Wyke Beds, Kimeridge Clay, and Lower London Tertiaries, and leaves him ignorant of the Permo-carboniferous ice-age, and of the immensely interesting development of life-forms and existing land-areas throughout Cainozoic times.

Dr. Dwerryhouse, however, deals excellently with the Pleistocene ice-age, taking here a bold wide survey. As minor criticisms, we do not like the term "Ammonoid" on p. 293, as applied only to forms intermediate between Nautiloids and "the Ammonites." Something seems omitted in the account of the origin of columnar structure on p. 317; the "forces acting at right angles to *ab* and towards 1 and towards 2" are just as "equal and opposite" as those differentiated from them by these terms. The whole point seems to lie in their directions.

It will be seen that this attractive book admirably fulfils its purpose. Any limitations in the last few pages cannot for a moment be ascribed to narrowness of outlook in the author. G. A. J. C.

OUR BOOK SHELF.

British Weights and Measures. As Described in the Laws of England from Anglo-Saxon Times. By Col. Sir C. M. Watson, K.C.M.G., C.B. Pp. xii+107. (London: J. Murray, 1910.) Price 2*s.* 6*d.* net.

THIS is an account of the history of weights and measures in England from the time of the Anglo-Saxons to the present day. It is meant to be of a popular character, and is written in an attractive manner, but as it includes the results of independent researches by the author, it may be of some interest to archæologists as well as to the general public. Sir Charles Watson appears to be an opponent of the introduction of the metric system in this country, and his book is in part intended to show that our present system rests on the experience gained by many centuries of legislation, and accordingly should not be abolished hastily in favour of a system of foreign origin and of comparatively recent date.

An interesting account is given of the various "pounds" which have been in use in England. The author is of opinion that the term "troy weight" is derived from an old English word "troi," signifying a balance, and that "avoirdupois" was a generic word used with respect to articles of considerable weight relatively to their value, which were sometimes weighed by a kind of Danish steelyard, or desemer, known as an "auncel." His identification of the gallon of Edward I. with the wine gallon of Queen Anne is not very convincing. He gives a good account of Gunter's chain, which he considers an excellent example of the kind of improvement that can be made with advantage in a system of weights and measures without introducing a new standard of measurement.

On the whole, the author is to be congratulated on having produced an eminently readable book on a subject which is often treated tediously. Some of his suggestions for the simplification of the British system given in the concluding chapter are deserving of consideration, but the proposal to abolish apothecaries' weight would be unlikely to meet with support in the professional circles mainly concerned.

On p. 24, line 8, "three-quarters of a yard" should apparently read "a yard and a half."

Newcomb-Engelmann's Populäre Astronomie. Vierte Auflage. In Gemeinschaft mit den Herren Prof. Eberhard, Prof. Ludendorff, Prof. Schwarzschild, herausgegeben von Prof. P. Kempf. Pp. xvi+772. (Leipzig: W. Engelmann, 1911.) Price 14 marks.

PRACTICALLY a generation has passed away since Newcomb's "Popular Astronomy" was first published. Many popular works have appeared since, but they have not supplanted the original work in its entirety, or provided a better model to which continual extensions could be added.

The main intention of the author has been kept in sight in the present edition. He did not cater for the professional investigator or the special student, but he aimed at placing before the general reading public a condensed view of the history, methods, and results of those portions of astronomical research that possessed a popular and philosophic interest. Like the last edition, the present has been entrusted to the staff of the Potsdam Observatory. This is fitting, since it is precisely in the department of astrophysics—the direction to which the energies of the Potsdam astronomers are more specially devoted—that the greatest progress has been made and the greatest need for revision exists. But other astronomers have ably cooperated. Prof. Schwarzschild has rewritten the section on the determination of orbits, and revised the chapter on cosmogony. Seeliger supplies the most recent details on the distribution of stars; Prof. Kobold revises the cometary statistics; Dr. Schweydar writes on the figure of the earth, and discusses recent hypotheses concerning its internal constitution. In this section we should have been glad to see more extended references to the work of Hecker.

Other sections which have been rewritten or extended are those on stellar parallax (Ludendorff), physical constitution of stars (Eberhard), motions of stars

(Ludendorff), variable stars (Kempf), new stars (Eberhard). On the general scaffolding that Newcomb contrived, later artists, it will be seen, have created a more complete and elaborate building.

Gehirn und Rückenmark. Leitfaden für das Studium der Morphologie und des Faserverlaufs. By Dr. Emil Villiger. Zweite auflage. Pp. vii+278. (Leipzig: W. Engelmann, 1910.) Price 12.80 marks.

WHEN the first edition of this book was reviewed in NATURE some four years ago, we then admired the lucidity of its style, and the excellent manner in which the author, Dr. Villiger, of Basle, arranged his description of the structure of the central nervous organ. The new edition is a considerable improvement upon the old. Beginning with a concise account of the embryology of the brain and spinal cord, the author proceeds to describe the gross anatomy of the brain, and illustrates his text by numerous excellent photographs and diagrams.

The second part of the work, dealing with the course of the various nerve-tracts and with the cranial nerves, is a model of luminous exposition. Many new diagrams have been substituted for those in the original edition.

The chief difference, however, is in the addition of an entirely new third part, consisting in a collection of more than fifty sections of the brain-stem. One set of these sections forms a series extending from the anterior end of the corpus callosum down to the corpora quadrigemina. The other series traces the structure of the various parts from the caudal end of the medulla oblongata upwards to the mid-brain. Each figure is accompanied by a full and descriptive text, so that the reader is provided with a fairly complete topographical atlas. Dr. Villiger's book bears the stamp of an expert teacher. It is difficult to give an adequate account of its many good points, and we trust that ere long it will become available to English readers in an authorised translation.

Thoughts on Ultimate Problems. Being a series of Short Studies on Theological and Metaphysical Subjects. By F. W. Frankland. Pp. xii+101. (London: David Nutt, 1911.) Price 1s. 6d. net.

THIS collection of studies on philosophical and religious subjects has now reached a fourth edition, which is sufficient proof that the author's treatment of profoundly important matters has appealed to a wide circle of readers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Stinging Tree of Formosa.

THE stinging effect of the common nettle (*Urtica dioica*, L.) is so well known that even a cursory reference to it seems to be superfluous. This stinging power of Urticaceæ is found to culminate in the genus Laportea, which exhibits in certain species a most virulent effect enduring for some days, or even months, in response to a light touch on one of the leaves.

During my botanical tour in the southern part of Formosa in 1909 I observed, in the district of Kōshun, an endemic species of the stinging tree (*Laportea pterostigma*, Wedd.) growing not infrequently in the mountainous districts of that part of the island, where it is called by the natives "Chiao-jen-kou," meaning "Man-biting-dog." It is mentioned in the revised edition, completed in 1747, of a Chinese book, the *T'ai-wan-fu-chi*, or a "Topography of Tai-wan Prefecture [in the Island of Formosa]," vol. xviii., fol. 21,[1] where we observe the following statement:—

"'Chiao-jen-kou.' . . . This tree attains to a height of more than ten feet, with the leaves long and large, resembling those of the tobacco-plant, and furnished with stinging hairs, which, when they sting a man, enter the hair-follicles and become so irritating that if lightly rubbed the colour of the skin becomes red, and the pain continues for a day and a night, after which it ceases."

Dr. Augustine Henry, in his "List of the Plants of Formosa" (Trans. Asiat. Soc. Jap., vol. xxiv., Suppl., p. 88), has already made a reference to this tree, as well as to the *T'ai-wan-fu-chi*, by stating that it is "a small tree, the leaves of which sting violently, known colloquially and in the Gazetteer as 'Yao-jen-kou' [='Chiao-jen-kou']; " he refers to it again (*loc. cit.*, p. 12), saying that "the 'Stinging-Tree,' a species of Laportea, is very unexpected in its effects on anyone ignorant of its quality." Reference is also made to this tree in an article, by the same gentleman, on the "Botany of Formosa," published in the *Kew Bulletin*, 1896, p. 70.

My botanical friend who accompanied me during the greater part of my tour in Formosa, and has had considerable experience in connection with the flora of that island, told me the following anecdote when we both saw before us the stinging tree growing wild in the southern part of the island:—

"A Japanese traveller who happened to be alone in some mountainous district in Formosa, rubbed unconsciously a part of his body with a leaf of this tree, which stung him so violently that he ran in madness and cried in agony of pain, and it took a day or so before he recovered. In examining some leaves collected from the same tree, they were identified as belonging to those of 'Chiao-jen-kou.'"

After hearing the above anecdote, I suggested a Japanese name, "Mamushi-no-ki," or "Viper Tree," as a warning to all who hearing this name that they should not dare to touch the leaves in future. As I remember that I observed myself a small tree, partly cut down, close to a cottage situated near the coast in the small harbour of Tai-han-roku, it appears to me that this tree is not uncommon in the southern part of Formosa.

In Messrs. Forbes and Hemsley's "Index Floræ Sinensis," ii., p. 472, and in Drs. Matsumura and Hayata's "Enumeratio Plantarum Formosanarum" (Tokio, 1906), p. 382, this tree is enumerated, but no reference is made to its remarkable stinging effect. In Mr. Kawahami's useful "List of Formosan Plants," recently published by the Formosan Government, a Japanese name of "Irakusa-no-ki," or "Stinging-Nettle-Tree," has been newly coined. In consequence of its powerful effect of stinging, the Japanese name of "Irano-ki," or "Stinging Tree," might be more appropriate.

There are some other species of Laportea which exhibit, even when slightly touched, a remarkably poisonous effect. In Engler and Prantl's "Die natürlichen Pflanzenfamilien," iii., 1 Abteilung, p. 106, the following statement concerning *Laportea crenulata*, Gaud., of eastern India, is to be found:—"Bei leiser Berührung mehrere Tage dauernde Schmerzen hervorrufend." Weddell (in De Candolle's "Prodromus," xvi., par. 1, p. 85) made the following reference with regard to the stinging effect of the same species:—"Quod ad vires nocuas stimulorum attinet vid. monographiam meam [*i.e.* Weddell, 'Monographie de la famille des Urticacées,' in 'Archives du Muséum d'Histoire Naturelle,' ix., 1856]." In the *Gardeners' Chronicle*, 1882, vol. xviii., p. 465, we find the following extract from *Knowledge* concerning the stinging effect of this species:—"The Stinging Tree of Queensland, Australia, is a luxurious shrub, pleasing to the eye

[1] The revised edition, above referred to, of the *T'ai-wan-fu-chi*, has now become very rare in Japan. In 1895, when Formosa was ceded to Japan, some wood-blocks of the *T'ai-wan-fu-chi* were found to exist in Taihoku, and consequently a new impression was made by the order of the Formosan Government. But soon afterwards these wood-blocks were destroyed by a conflagration, with the exception of a few blocks, which are now preserved in the Government Museum at Taihoku. Even the new impression is now out of print, so that it is not too easy to obtain a copy in Formosa. I, however, lately secured a complete copy of an old (*i.e.* Chinese) impression in Tokio.

but dangerous to the touch. It grows from 2 or 3 inches to 10 or 15 feet in height, and emits a disagreeable odour. Says a traveller: 'Sometimes, while shooting turkeys in the scrub, I have entirely forgotten the stinging tree till I was warned of its close proximity by its smell, and have often found myself in a full forest of them. I was only once stung, and that very lightly. Its effects are curious. It leaves no mark, but the pain is maddening, and for months afterwards the part when touched is tender in rainy weather, or when it gets wet in washing, &c. I have seen a man who treats ordinary pain lightly rolling on the ground in agony after being stung, and I have known a horse so completely mad after getting into a grove of the trees that he rushed open-mouthed at everyone who approached him, and had to be shot. Dogs when stung will rush about whining piteously, biting pieces from the affected parts.'" Mr. N. E. Brown, of the Royal Gardens, Kew, made an interesting contribution (*Gard. Chron.*, *loc. cit.*, p. 567) of his personal experience concerning the virulent effect of the sting of this species in the palm-house at Kew. TOKUTARO ITO.

Tokio, January 25.

The Sailing-Flight of Birds.

SINCE Mr. F. W. Headley urges (February 16, p. 511) readers of NATURE to make observations on the flight of the albatross, possibly a few remarks may be of interest from one who, as a student of aërodynamical problems, has carefully watched such wonderful performances.

One point which has always struck me is that the albatross almost invariably flies in immense circles, ever varying in size and direction. Sometimes the bird will be high overhead, then, swooping down on a curve, will skim closely over the tops of the waves, then suddenly rising again will float away to perhaps half a mile off, gradually sweeping around, and perhaps again attaining a considerable elevation. It seems quite impossible to decide, from observation, whether the elevation is gained from uptending winds. Without doubt, the bird takes every advantage of each puff or eddy he can find, but he does *not* progress, as in Mr. Mallock's figure, steadily from wave to wave, rising and falling with the waves. Nor does he, so far as one can judge, invariably rise when facing the wind, and *vice versa*. That albatrosses, as well as other birds, seem always to soar in circles, may be due to the circumstances that, for instance, in following a ship, they have to circle round and round in order to keep near it, not being able to fly at such a slow speed as that of the ship (and therein is a hint to our cross-Channel aviators). So too vultures and eagles may soar around, not wishing to depart from the district which they are watching. But the question to which I have long wished for a reply is, "Can birds soar in a straight line?" I remember many years ago seeing, on the Nile, flocks of pelicans gliding along on outstretched wings. Now these birds were progressing up the river, performing actual journeys, but I cannot remember whether they were actually soaring in a straight line all the time.

I have frequently noted, what is patent to all, that in calms there is no true soaring; also I feel sure that there is no kind of motion of the wing such as Mr. Hearn suggests. One thing is certain, and that is that a soaring bird, especially the albatross, always progresses at great speed. Having once obtained the initial impulse, there is so very little head resistance offered to forward motion by the bird that the speed slackens but little. He progresses, as described by Langley, in the manner of a skater skimming over thin ice, travelling so fast that the ice has not time to break.

Much of interest on this matter is to be found in the old annual reports of the Aëronautical Society. In that for the year 1868 there is an interesting discussion in which Mr. Young is quoted as saying that he had noticed "the hollow form of birds' wings; these were not planes; indeed, a little consideration would show that the curved surface is better than a true plane. . . . He concluded that the best means of flight is by a curved wing." A great deal has been said on this subject during the last few years, but how many have read these old, and often instructive, discussions? B. BADEN-POWELL.

The Non-simultaneity and the generally Eastward Progression of Sudden Magnetic Storms.

Fact.

IT will be necessary, first, to my regret, to direct attention to some further errors in Dr. Krogness's communication in NATURE, December 8, 1910, p. 170, to which I made reply in the issue of January 5, p. 306. He questioned the correctness of our time of beginning of the disturbance, May 8, 1902, as recorded on the horizontal intensity curve at Potsdam, viz. 12h. 0m. Greenwich mean civil time, whereas his determination for the same station was 11h. 58m. In my reply, I stated (*idem*, p. 307) that Dr. Krogness must have made an error somewhere, for, upon repetition of our time scalings, based upon the data supplied us by the Potsdam Observatory, we got our identical result. I next wrote to the Potsdam Magnetic Observatory and requested that the time be scaled with all possible accuracy from the *original* magnetogram. Under date Potsdam, January 20, 1911, Dr. Venske gives the time in question as 11h. 59·7m., hence within 0·3m. of our time, but differing 1·7m. from that of Dr. Krogness.

Furthermore, in compliance with a circular request, I am receiving almost daily from observatories over the whole globe fresh data on the fifteen sudden disturbances, July 29, 1906, to September 25, 1909, first investigated by Mr. R. L. Faris for the five Coast and Geodetic Survey observatories. It will be recalled that Mr. Faris's data had furnished important testimony on the question as to the strict simultaneity of abruptly-beginning disturbances. Both Drs. Chree and Krogness have attempted to break down this testimony, but the data received thus far from other observatories are bearing out the conclusions previously drawn.

Table I. contains the time data for the very same disturbances chosen by Dr. Krogness. Confining our attention to the horizontal intensity disturbance curves, just as he does, we have first the mean time of beginning as derived from the five Coast and Geodetic Survey observatories (Faris's data, the means being formed by Dr. Krogness; for the last disturbance the record at Sitka was missing, so that in the mean only four observatories are embraced). Next is given the times of beginning for the Potsdam Observatory, first as derived by Dr. Krogness and employed in his communication (*idem*, p. 171), next as recently scaled by Dr. Venske at Potsdam, using the *original* magnetograms. Forming the differences P (Potsdam), U (United States), it is seen that for the Krogness scalings there are three plus differences, two minus ones, and one zero, resulting in an algebraic mean of but +0·03m. The case is, however, different for the next column, which depends upon the Venske, *i.e.* the *original* data of the Potsdam Observatory; there are now five plus differences and but one minus, the algebraic mean being +0·47m. or 0·44m. higher than that of Dr. Krogness. These differences (P-U) are small quantities, to be sure, but the interesting point is that, in every instance, for the Venske figures they are in the same direction as determined by me from the five Coast and Geodetic Survey observatories alone, and as published in *Terrestrial*

TABLE I.—*Greenwich Mean Civil Times of beginning of Disturbances in the United States and at Potsdam.*

No.	Date	United States	Potsdam		P–U		Direction
			Krogness	Venske	K	V	
		h. m.	m.	m.	m.	m.	
20	1906, July 29	19 56·12	57	56·5	+0·88	+0·38	E.
24	1907, July 10	14 22·92	22·5	23·2	−0 42	+0·28	E.
25	Oct. 13	7 42·36	42·5	43·7	+0·14	+1·34	E.
28	1908, Sept. 11	7 20·82	20·3	20·7	−0·52	−0·12	W.
30	Sept. 28	8 42·00	42	42·6	0·00	+0·60	E.
31	Sept. 29	1 31·68	31·8	32·0	+0·12	+0·32	E.
	Algebraic mean				+0·03	+0·47	
	Numerical ,, ...				±0·35	±0·51	

Magnetism, vol. xv., p. 231, Table VIII., Nos. 20, 24, 25, 28, 30, 31. The letters E (motion of disturbance eastward or plus motion) and W (minus or westward motion) given in the last column are as taken from Table VIII. spoken of; note how the plus sign is linked each time with E and the minus with the W. Surely the most captious critic will hardly contend that this is mere chance.

As judged by the Venske data, Dr. Krogness's time scalings are in error from −0·5m. to +1·2m., and, on the average, +0·43m., his general tendency being to measure the Potsdam time *too low* by almost 0·5m. It must hence not be surprising that he failed to detect the generally eastward progression in the times between the United States and Potsdam, and was, instead, led to negative results; the difference of half a minute is precisely on the order of the required quantity.

Dr. Krogness, in his communication (*idem*, p. 171), unwittingly revealed also that the time scalings of his chief —Prof. Birkeland—were likewise untrustworthy. In order to get some definite information regarding the methods employed, Prof. Birkeland was next appealed to directly, but unfortunately in a reply received from him he failed to answer my question. It is recommended that all time data which appear in Prof. Birkeland's vol. i. (Norwegian Aurora Polaris Expedition, 1902–3) be used with extreme care by anyone who wishes to look into the matter of simultaneity of abruptly-beginning disturbances. I am not surprised now that Prof. Birkeland was unable to reach any definite conclusion himself on this interesting and important question, for his data lacked the necessary refinement.

Since I am on record as believing that no implicit reliance is to be placed upon simply one observatory, no matter how excellent its instrumental equipment and methods may be, Table II. is next given for the fifteen

TABLE II.—*Greenwich Mean Civil Times of beginning of Disturbances in North America and Europe.*

No.	Date	North America	Europe	E–N	Direction: U.S. and Europe	Direction: U.S. alone
		h. m.	m.	m.		
20	1906, July 29	19 56·15	56·52	+0·37	E.	E.
21	Aug. 7	13 38·50	38·78	+0·28	E.	E.
22	Dec. 21	21 30·70	30·87	+0·17	E.	E.
23	1907, Feb. 9	14 12·72	12·79	+0·07	E.	E.
24	July 10	14 22·85	22·79	−0·06	W.	E.
25	Oct. 13	7 42·50	44·17	+1·67	E.	E.
26	1908, Mar. 26	17 41·25	41·65?	+0·40?	E.?	W.
27	Aug. 19	0 14·35	14·31	−0·04	W.	W.
28	Sept. 11	7 20·87	20·47	−0·40	W.	W.
29	,, 11	21 47·48	46·51	−0·97	W.	E.
30	,, 28	8 41·97	42·20	+0·23	E.	E.
31	,, 29	1 31·20	32·56	+1·36	E.	E.
32	1909, May 14	4 55·40	56·77	+1·37	E.	E.
33	Sept. 25	8 39·70	38·43	−1·27	W.	W.
34	,, 25	11 41·80	40·33	−1·47	W.	W.
	Mean of positive values			+0·66	9 E. 6 W.	10 E. 5 W.
	,, negative ,, ...			−0·70		
	Mean regardless of sign			±0·68	For a great circle arc of 75°	
	,, ,, ,, ...			±0·82	For a great circle arc of 90°	
	,, ,, ,, ...			±3·3	For a complete circuit	

disturbances spoken of above; in this all the observatories are embraced the data of which have been received to date, February 10, excepting one the time scalings of which differ occasionally 10m. or more from near-by institutions, and are doubtless subject to some error. The "North American group" embraces the six observatories Honolulu, Sitka, Baldwin, Agincourt (Canada), Cheltenham, and Porto Rico, the mean geographic position being 36·3° N., 101·7° W., of Greenwich; the "European group" gives the mean times for the seven observatories Stonyhurst, Greenwich, Uccle, Wilhelmshaven, Munich, Potsdam, and Katharinenburg, the mean geographic position being 52·4° N., 13·6° E., of Greenwich. It will be noticed that Kew is not included, for the simple reason that, although Dr. Chree scaled the required data some months ago, he has not yet published them nor forwarded them to me. The Greenwich data were received the earliest of all, viz. January 23, and those of the distant Observatory of Katharinenburg on February 9. The numbers attached to the various entries in Table II. correspond to those in my Table VIII. (*Terr. Mag.*, vol. xv., p. 231).

The last two columns ascribe the direction of progression of the disturbance according to the sign of the difference E–N, plus meaning east. First the direction is given as derived from the present investigation, which depends upon data over the region from Honolulu, 158° W., to Katharinenburg, 60·6° E., and next as obtained previously from the five Coast and Geodetic Survey observatories alone (Honolulu, 158° W., to Porto Rico, 65·4° W.). Comparing the two columns, it is seen that only in three cases out of fifteen, viz. Nos. 24, 26, and 29, do the letters clash; in other words, in 80 per cent. of the cases the directions, as determined from the limited portion covered by the United States observatories, agree with those now gotten for a considerably larger region. Moreover, Nos. 24 and 29 exhibit the interesting fact that while the disturbance each time progressed eastwardly in Europe just as it did in the United States, yet the mean time of occurrence for each is less in Europe than in North America. These are precisely similar cases to the disturbance of May 8, 1902, which seemingly began in the Atlantic and Europe, and then travelled eastward, being felt last in the United States. When the data for the observatories in Asia are available, the actual direction of progression of the two disturbances Nos. 24 and 29 will be known better. This shows, as I have already pointed out, how important it is to know approximately the region where the disturbance originated (cf. *Terr. Mag.*, vol. xv., p. 20). The result from No. 26 is more or less doubtful, evidently the point of beginning being not sufficiently sharp at all stations; three of the observatories mark their times doubtful, and two omit giving them.

Both columns unite in showing that the eastwardly progressing disturbances predominated over the westwardly ones in the ratio of about two to one. The average difference E–N, regardless of sign, is 0·68m., which was the average time required for a disturbance to pass from the mean position of the North American group to that of the European, or over a great circle distance of 75°. If the disturbance continued to progress at this rate, and were to make a complete circuit of the earth, it would take 3·3m., hence on the order of the quantities already announced. The linear velocity here concerned would be about 200 km. per second.

The available data on the non-simultaneity and progression of abruptly beginning disturbances have now been subjected to so many severe tests that it is difficult to see how anyone with an open mind can any longer doubt that some important discoveries concerning magnetic disturbances have been made. I should, indeed, be glad to be informed of any other facts in terrestrial magnetism which have stood as well the tests applied.

Dr. Chree, unfortunately, in his paper before the British Association last summer, and again before the Physical Society of London on November 11 last (Proceedings, vol. xxiii., part i., December 15, 1910 [49]), devotes chief attention to pointing out difficulties in explanation. He seems more concerned in determining why, according to his ideas, the phenomenon should not be rather in finding out whether it *is*. One of the chief purposes of my paper was to arouse further investigation on the part of others. Dr. Chree could not have done better than immediately to have published his own data in the same open manner that Mr. Faris had done. Instead, he labours to discredit the Coast and Geodetic Survey observations, and withholds his own from public scrutiny. In half the interval of time between the first and second presentation of his

paper, had Dr. Chree chosen, he could have had at his command data from Europe and Asia which, combined with his own, would have served admirably to have tested the main contentions. He might thus have been credited with a really helpful contribution to the subject; but no such attempt has been made.

In view of the discussions which have arisen with regard to time data from present magnetograms, I have made request of each observatory for a statement of the method employed. From the reports thus far received, it is found that no institution has made a more earnest attempt to allow for all sources of error than is the case at the Coast and Geodetic Survey observatories. It is evident that in several instances equal care, for one reason or another, is not given by others, but, judging from the fresh interest aroused by the present investigations, there is every reason to expect considerable improvement hereafter. This may be a sufficiently useful end to have achieved, even if nothing else had resulted from the researches.

Theory.

The hypothesis of ionic currents which I have employed in the study of magnetic disturbances thus far treated is based on the existence of a primary set of electric currents circulating around the earth overhead. Quoting from my paper No. 1 (*Terr. Mag.*, vol. xv., pp. 122–3):—

"Since magnetic observations made at various points on the Earth's surface have revealed the existence of a definite system of atmospheric electric currents, it follows at once that if the atmosphere is made more conducting at any point, an extra current will be started and set in motion by the pre-existent electromotive force or its equivalent. The direction followed by the new current depends upon its origin, upon the direction of the electromotive force at that point, and upon the deflecting effect of the Earth's magnetic field and of the Earth's rotation on the electric carriers. In other words, while we shall look chiefly to extra-terrestrial agencies for ionising the air and thus splitting it up into carriers of positive and of negative charges, we look to the atmospheric electric field and to the Earth's rotation for furnishing the energy necessary to drive the ions over the Earth and by their motion produce the effects observed during a magnetic storm."

In No. 3 (*idem*, vol. xvi., p. 34) I summarise the evidence available regarding the outside electric field as based upon the harmonic analyses of the earth's magnetic condition by Adams, Schmidt, and Fritsche. I show that its general characteristics are very similar to the supposedly internal magnetisation of the earth. The outside currents, if negative ones, would have to circulate around the earth from west to east, hence in the same direction as the rotation of the earth. Starting with these currents, I find it possible to account for the earth's own magnetisation if the earth's average magnetic permeability is on the order of 135 as referred to air and for a magnetising force of about 0·0024 C.G.S. This value, while seemingly large, is not impossible, judging from the experiments of Lord Rayleigh and of C. Baur on iron, using small magnetising forces. Furthermore, it must be borne in mind that we are absolutely ignorant as to what effect the great pressures existing at but a few kilometres below the surface may have on the permeability of magnetisable substances—possibly the effect of increased temperature with depth may be completely annulled by the comparatively more rapid increase in pressure.

In brief, I have set up the hypothesis that the earth is chiefly an electromagnet, the magnetising currents being outside, and consisting of negative electric currents circulating overhead in the same general direction as that of the earth's rotation. I follow out the consequences, and show that this hypothesis harmonises with the Gaussian analysis, from which it had been hitherto almost universally concluded that the magnetising causes must be contained chiefly *inside* the earth.

By thus putting the magnetic state of our planet primarily in the control of *outside* electric currents, many of the outstanding problems of terrestrial magnetism are greatly simplified. Any variation, periodic or spasmodic, in the intensity and direction of the magnetising currents must, of course, be followed almost immediately by corresponding changes in the earth's magnetisation. It thus becomes clearer now how, in the space of but a few minutes, such great changes can occur in the magnetic condition of our planet as are experienced during magnetic storms. Anything that will cause a change of conductivity in the strata containing the outside currents will evoke changes in the latter, which in turn are revealed in effects on our magnetic needles. There may be many such causes—the theory need not restrict itself to any one, as, for example, kathode rays.

Analysing the type of disturbance of which the one of May 8, 1902, may be taken as typical, it is seen that we have before us but a miniature reproduction of the earth's own magnetisation. In brief, a system has been found which will produce magnetic disturbance effects precisely similar to the permanent magnetic effects referred to the earth (*idem*, vol. xv., pp. 25–30, 117, and vol. xvi., pp. 33–48).

The type of disturbances which Prof. Birkeland refers to "equatorial" currents is thus found to be merely a general disturbance of the entire magnetic condition of the earth, of such a simple character that the first harmonic may give a sufficiently complete representation of the observed perturbations. The theory advanced in my papers is that the same electric-current system which may have to be held accountable for the production of the earth's magnetisation will also suffice for the production of the disturbances considered. I propose the name, therefore, of "simple magnetic perturbation," in place of Prof. Birkeland's "equatorial magnetic perturbation," adding the words "positive" or "negative," just as he does, according to whether the general effect is to increase momentarily the earth's magnetisation or to decrease it. Prof. Birkeland and I are not in agreement as to the direction in which the outside currents must go to produce the observed magnetic effects (*idem*, vol. xvi., pp. 33–48).

The careful reader will not fail to observe that the theory, as above briefly outlined, is considerably different from that which Dr. Chree imputed to me on p. 51 of his paper cited above. Furthermore, the calculation which he says he is unable to follow, although others have done so, was merely a preliminary attempt to account for the observed progression of sudden disturbances and to get some idea as to the order of the altitude at which the supposed currents would have to circulate. If Dr. Chree has something better to offer I shall be glad to know it. Such interest is being manifested now on all sides, that it will doubtless not be long before a fairly satisfactory theory will be forthcoming. Someone must make the attempt, however, to rear a structure; not all of us are willing to rest contented with merely pulling down. One correspondent has hit upon another promising clue, which is at present being tested. In the meanwhile, I believe our hypotheses have amply justified themselves by the many new questions raised and the fresh incentives given to investigation.

L. A. BAUER.

Washington, D.C., February 10.

Postscript.—From NATURE of February 2, just received, it is noticed on p. 461 that Prof. Schuster presented a paper before the Royal Society on January 26 entitled "The Origin of Magnetic Storms," in which a critical examination is made of the theory that magnetic storms are caused by streams of electrified corpuscles ejected from the sun. Prof. Schuster, after various calculations, reaches the following conclusions:—

"If magnetic disturbances are produced by rays emanating from the sun, it can therefore only be in an indirect manner. We may imagine that the injection of corpuscles ionises the upper portions of the earth's atmosphere, and consequently renders the already existing electromotive forces more effective, or we may imagine that the approach towards the earth's magnetic field of highly conducting material containing ions of both kinds acts by induction. The effect of such induction would primarily be an increase in the horizontal and a diminution of the vertical forces, while the currents induced in the earth, tending to diminish the horizontal forces, would, owing to the inertia, die out more slowly, so that a semi-permanent effect would be left after the storm."

It will be seen that the theory as set forth in my paper above is entirely in harmony with Prof. Schuster's conclusions; it is, in fact, largely based on his previous re-

searches. He and I are in agreement that the real origin of our magnetic disturbances is to be referred primarily to an outside electric system situated somewhere in our own atmospheric regions. I go one step further, and place in the same region the chief origin of the earth's own magnetisation.

In conclusion, it will be well to point out that the method used in my Table II. above to get the average rate of progression of sudden disturbances does not accentuate the actual time differences between distant stations, but tends rather to diminish them, as was the case with storms Nos. 24 and 29. In brief, as I have already hinted, the precise method of grouping of stations cannot be a fixed one, but must vary with the region in which the disturbance originated. When the data from the remaining parts of the globe have been received, this matter will become more evident. L. A. B.

Washington, D.C., February 13.

Colliery Warnings.

MAY I say a word about colliery warnings to point out that it is not the high barometer that is of any importance, but the dryness of the air? It happens in our country that the high barometer and dry air generally come together.

Gas explosions in coal mines are trivial, and they occur on an average of more than one per day. It is when there is sufficient dust to make the explosion spread over a big area that an explosion is serious, almost without exception. Dry air is the danger, and should be the basis for "colliery warnings." JOHN HARGER.

University Club, Liverpool, February 21.

IN all collieries more than 600 or 700 feet in depth the air is always dry—somewhat drier in cold than in warm weather—and, consequently, coal-dust is always present in the workings provided there is no natural "seepage" of water into them. In these circumstances, the one essential element of a great explosion is always present.

Blasting shot, when fired under certain conditions, and comparatively small volumes of explosive gas when ignited, will always raise and ignite coal-dust the quality of which, as regards its contents in volatile matter and ash, lies between certain upper and lower limits. On the other hand, shots are always being fired, and larger or smaller accumulations of explosive gas are always being formed here and there in mines of this class, quite irrespective of weather conditions.

All that can be said as regards the influence of weather is that, other things being equal, a coal-dust explosion is more likely to occur in cold weather, when the mines are driest, than in warm weather, when they are not so dry, and with a falling rather than with a steady or rising barometer.

These subjects were fully discussed at the very inception of the coal-dust question, and Mr. Harger might do well to study what was then said about them.

As the issuer of "Colliery Warnings" so frequently advocates that special attention be paid to the condition of mines when the barometer is rising rather than when it is falling, I may perhaps be allowed, in this place, to correct a statement which lately appeared in a letter to NATURE, written by "The Author of the Warnings," to the effect that Mr. R. H. Scott and I were amazed (*sic*) to find that fire-damp was frequently reported to have been found in mines even when the barometer was steady and rising. We were not amazed, for we knew by the actual experience of one of us that, in consequence of falls of roof, damage to trap-doors, stoppings, brattices, and so on, which are amongst the commonest incidents in mining, the ventilation often becomes so stagnant at certain critical points that the air becomes explosive at or near these points before the defects can be rectified.

As a matter of fact, the principal province of the firemen is to guard against this very contingency. Consequently, when we saw appearances of fire-damp reported time after time with a steady or rising barometer, we experienced no surprise, but, perhaps rather unfortunately, considering the use the "Author of the Warnings" has made of the sentence in which we merely recorded a fact without further comment, we did not stop to explain what passed in our own minds at the time, but proceeded in the next following sentence to show that, when the records of a large number of mines were compared, the effect of these casual irregularities was practically eliminated altogether. It would have been fairer if the "Author of the Warnings" had quoted one more sentence (Quarterly Journal of the Meteorological Society, October, 1874).

W. GALLOWAY.

The Hydrogen Spectrum.

THE colour of the light which is emitted from the capillary of a vacuum tube containing pure hydrogen is the familiar vivid, deep pink, the prevailing tint being due to the predominating brilliance of the red line ($H\alpha$). When the same capillary is viewed from one end, however, the colour is a very pale pink, indeed, nearly white.

This interesting effect appears to be due to the different relative intensities of the lines $H\alpha$ and $H\beta$ in the two cases, for while $H\beta$ (and probably each of the other lines in the primary series) has an intensity appropriate to the length of the column of gas in the capillary, $H\alpha$ appears to suffer reduction.

In the course of some observations on the secondary spectrum of hydrogen, during which I had occasion to use the tube when placed against the slit of the spectroscope in the usual way, and also end on, I was greatly interested in this apparent variation in the intensities of the lines mentioned. The explanation which suggests itself is that $H\alpha$ is weakened by absorption in traversing the column of gas (although this distance is only about 5 or 6 cm. in my tube), but it is difficult to understand why this absorption should be specially selective for $H\alpha$ and not equally effective in the case of $H\beta$, which is also a very brilliant line, and to which one would imagine the same argument would apply. There appears to be no reason for attributing the effect to polarisation.

I have seen no notice of this effect, but I imagine it must be quite familiar to spectroscopists, and perhaps one of them who has devoted special attention to the hydrogen spectrum may be able to throw some light on the matter.

CHARLES W. RAFFETY.

Beechcroft, 2 Park Hill Road, East Croydon, Surrey, February 22.

Life and Habit.

ON p. 505 of NATURE for February 16, in a review of a new edition of one of Samuel Butler's books, these words appear:—"therefore the apparently unpractised but perfect pecking of a newly-hatched chick proves that the chick has done it before," &c.

Now, I have tried many experiments with chicks hatched out singly and away from a hen, but never has any chick attempted to peck until shown how to or made to walk over food which tickled its toes, and my opinion is that a chick might die of starvation while surrounded by food unless taught what to do. They are quick to take a hint, and will imitate the motion and action at once if a bent finger be worked up and down like the head of a bird when pecking; and, if once they feel a bit of food within their beaks, they know what to do with it as well as a new-born babe knows how to suck when anything is placed in its mouth, though they have never done it before. W. H. M.

February 20.

YOUR correspondent's remark is interesting, but, of course—as he himself indicates in connection with the babe—it does not invalidate Butler's argument. It can hardly be doubted that observation and imitation do not cover the ground, and that there is something calling for explanation in what is called "instinct"—a word which, it must be admitted, only disguises our ignorance of what it is. Butler's theory that "heredity is memory" is at least worth consideration. THE REVIEWER.

FOREST LIFE IN INDIA.[1]

IN these pleasant pages the author looks back cheerfully upon some of the events of thirty-five years in the Indian Forest Service, from the less responsible stage of assistant-conservator of forests, seeking the bubble reputation even in the tiger's mouth, to the more severe and formal stage of inspector-general, full of wise saws and modern instances. Of the gloom and monotony of existence far from the busy hum of men, and of the great and manifold dangers that surround life in a tropical jungle remote from all medical resources, he prefers, like a good Briton, to say nothing, though he must know all about them, and could no doubt make moan if he chose.

In the chapters covering the author's earlier terms of service as a junior executive officer in Oudh, and on the Nepal frontier, the moving incidents of sport predominate, and we are told much—though nothing, perhaps, very new—of the ways of the beasts that perish by the rifle. There are several accounts of the author's own experience of man-eating tigers; some, of course, tales of woe and death, but one—telling how an Indian peasant woman, with nothing but a sickle in her hand, attacked and beat off a man-eater that had seized her husband—might, if the heroine's name were known, be immortalised in the archives of the State.

FIG. 1.—The Baspa Valley. From "Forest Life and Sport in India."

With the advent of greater official responsibility the full tide of sport begins to ebb, and we are introduced to those questions of organisation and policy, which are the chief care of an administrative officer, and reveal the more serious purpose of the book. All these questions are treated with skill and tact. Among other things, we learn how far-reaching reforms of various kinds were effected, sometimes in the face of official indifference and misunderstanding; how native opposition to any interference with misconceived and misdirected "natural rights" was gradually overcome, so that suspicious villagers and destructive wild-men were at length converted into the ready tools of the forest conservator; and how institutions for the higher training of the forester are becoming engrafted on the educational system of the country. In short, we get from this excellent book not only a good idea of a forest officer's work in every grade, and of the main line of development of the Indian Forest Department, but also an insight into the many ways, direct and indirect, whereby well-managed forests contribute to a country's welfare.

This being one of the chief lessons of the book, we think that the author errs when, in discussing the relation of forest to ground-water, and so to agriculture, he speaks of forestry and agriculture as simple industries in comparison with the "*more important* manufactures that add to the national wealth." Surely at a time like the present, when England has grown all one-sided by neglect of agriculture, and whole masses of Englishmen deafened by machinery and blinded by smoke are in danger of losing their bearings, it were pity if a man who has lived half a lifetime in the precincts of Demeter did not boldly assert that as long as workmen require bread and butter and meat, so long must their most important accomplishments in the way of manufacture and all their additions to the national wealth wait upon the sturdy yeoman, who, like another Atlas, bears the civilised world upon his shoulders.

As a good Anglo-Indian of the olden style, the author thinks of his native subordinates and native servants as fellow-men, and always speaks kindly of them, and he regards red-tape with a noble aversion. On the other hand, he probably overrates the value of

[1] "Forest Life and Sport in India." By S. Eardley-Wilmot, C.I.E. Pp. xi+324. (London: Edward Arnold, 1910.) Price 12*s.* 6*d.*

the so-styled "expert specialist" of recent device; we have heard of this sort before, notably in connection with Indian agriculture, where he has been weighed and found—not altogether infallible. Life is compromise, and perhaps the best expert for India still is the service-man with a particular natural bent; the author almost admits this in his remarks upon the Forest School at Dehra Dun.

Much might be said of the illustrations, from photographs by the author's wife, that adorn the book. Some of them stir the heart "like the sweet sound that breathes upon a bank of violets."

FIG. 2.—A "Fire Line" in the Gonda Forests From "Forest Life and Sport in India."

DISTINGUISHED ANIMALS.[1]

IT may be said at once that any parent, guardian, uncle or aunt, who is on the look-out for a suitable gift-book to present to intelligent boys and girls, will find what he wants in Mr. Perry Robinson's "Of Distinguished Animals." A better school prize could not be given. But it is not quite the type of book suited for a review in NATURE, nor was its original prototype—a series of articles—quite up to what is expected now by the readers of *The Times*, which in the course of the year 1909 published a large proportion of this book under the title of "Studies in the Zoological Gardens."

This class of writing on natural history is somewhat out of date for grown-up readers, and, above all, subscribers to *The Times*. That *The Times* should deal with zoology or any other "ology" is what one would expect of it from time to time, but articles which it might publish on zoology, anthropology, botany, or horticulture, should invariably be written by specialists who can bring new facts to our notice and place before us convincing, perhaps startling, deductions. Otherwise, it may be said without peevishness that mature readers to-day are becoming a little tired of the "literary" treatment of such subjects, especially those connected with biology. The truth is of itself so marvellous, so spectacular, and interesting (if rightly put) that we do not wish for references to what imperfectly educated poets and prose writers thought of this or that beast or plant before the twentieth century, unless, of course, anything can be extracted from old writings throwing a fresh light on questions of geographical distribution, domestication, and the inter-relations between man and other forms of life.

The work under review is abundantly supplied with some of the best photographs that have ever been published of beasts, birds, and reptiles. But it does not contain much original matter in its letterpress, which is avowedly a long string of quotations intended to illustrate a number of remarkable types of beast, bird, and reptile, to be seen in the London Zoological Gardens. Not many of these quotations are new to the practised student of zoology, and a few of them are not quite true either in the facts they relate or in the deductions to be drawn from them. In the reference to the gorilla (p. 129), the assertion that the "gorillas" alleged to have been brought back by Hanno, the Carthaginian, from the west coast of Africa, "can hardly have been other than baboons," is not one which can be maintained, if the statements relating to Hanno's expedition are carefully considered in connection with the critical remarks thereon in Sir Thomas Bunbury's "History of Ancient

[1] "Of Distinguished Animals." By H. Perry Robinson. Pp. x+234. London: W. Heinemann, 1910.) Price 6s. net.

Geography." All that we know of this subject makes it nearly conclusive that Hanno's expedition reached as far as Sherbro Island, at the eastern limit of the Sierra Leone district, and that the wild, hairy men and women brought back by his people were the chimpanzees which still inhabit the forests of the Sherbro district. The Carthaginians were well enough acquainted with the baboon (which in those times was found not only in Egypt, but in the Tunisian Sahara), and would not have remarked on it with the same emphasis as they did, evidently, in connection with the chimpanzee skins.

FIG. 1.—Two Baby Anthropoid Apes." From "Of Distinguished Animals."

An allusion is twice made—not necessarily with credence—to Rudyard Kipling's story of "Bertran and Bimi." The theme of this was that a German residing in the Malay Archipelago possessed a huge orang which was so jealous of his newly-wedded wife, that upon the woman being left alone one day it tore away the thatch of her house, entered her bedroom, dragged her from the bed, and destroyed her. Here is an instance where "literature" steps in and tries to improve on fact, with disappointing results. Mr. Kipling's story was based on a real incident which occurred (to the knowledge of the present writer) in South Africa, where a huge Chakma baboon really did, in like circumstances, kill, or attempt to kill, the young wife of his master. Anyone who knows baboons and their extraordinary jealousy might well believe in the truth of such an incident, but as applied to the orang utan—to anyone who knows the

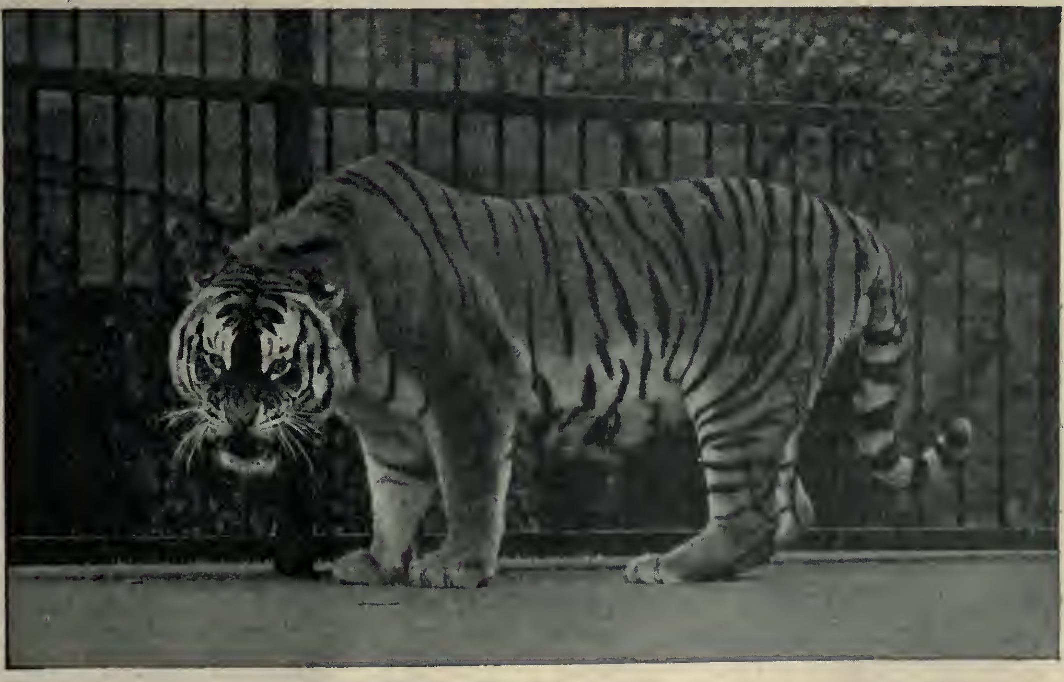


FIG. 2.—Siberian Tiger. From "Of Distinguished Animals."

orang—it is unbelievable and inapposite, and consequently is one of the few unconvincing stories in Kipling's otherwise admirable and truthful studies of the East.

But the author of "Distinguished Animals" cannot be held responsible for Mr. Kipling's rare slip in accuracy, and it is pleasanter to assert the general interest which the work under review possesses (apart from its remarkably good illustrations) for those who are not well acquainted with the history and habits of that marvellous collection of living creatures to be seen in Regent's Park. H. H. JOHNSTON.

THE KANGRA EARTHQUAKE OF APRIL 4, 1905.[1]

DESTRUCTIVE earthquakes are, fortunately, rare events, and when a civilised country is visited by one, the talk of investigating and of writing the report, which is now considered obligatory, falls necessarily on someone who has often more regular occupation. Hence it comes that we have to wait years for a connected account of a great earthquake, and that which visited the Punjab on April 4, 1905, is no exception; after the lapse of more than five years, with all the dignified delay, and, it must in fairness be added, all the thoroughness worthy of a great Government, the report on this earthquake, by Mr. C. S. Middlemiss, has appeared.

Nor could the memoirs have appeared more opportunely. The glamour of the great disaster which followed on the Californian earthquake, the remarkable character of the earth-movements which took place along the length of the San Andreas fault, and especially the fact that a very large part of the peculiarities of distribution of the shock seemed explicable on the hypothesis that fault and earthquake were related as cause and effect, have all given impetus to the popular notion that earthquakes are always a necessarily due to fracture. Yet even where faulting is observable there are generally indications that the fault is certainly not the sole cause, if it may be properly regarded as a cause of the earthquake; and now we have an account of a shock comparable in extent and violence with the Californian earthquake examined with great care and thoroughness of which the reporter writes that:—

> it may come as a surprise to many to be assured that the Kangra earthquake presents no evidence at all in support of this view: not a single railway has recorded any damage to the track, not a single road or path has been deflected, raised or lowered, no rivers or streams have changed their courses or been temporarily dammed up—except as due directly to landslips from slopes of such steepness that they might as easily have occurred after a heavy torrential rainstorm.

The greater part of the report is taken up with details of damage done to buildings, the sensations of observers and other stock subjects, in all of which little or nothing of novelty can be found; but when we come to the discussion of the cause of the earthquake there is much that is interesting and suggestive. The author, after discussing the nature of the origin, finally adopts the conclusion that there were two centres of origin, one in the Kangra valley and the other in the Dehra Dun. He points out that these two regions lie in imbayments of the great faulted boundary between the rocks of the Himalayas proper and the Tertiary beds originally formed as fringing deposits of Himalayan débris.[1] Moreover, it is just in these imbayments that an exceptional development of coarse boulder deposits indicates the position where great rivers issued from the mountains, where sedimentation was in excess, and where, in the subsequent compression and folding of strata, irregularities of packing might be expected to occur. So the conclusion is reached that the earthquake was a tectonic one, due to a sudden rupture or release of

FIG. 1.—Fallen Rock near Manoli. From "The Kangra Earthquake of April 4, 1905."

[1] Memoirs of the Geological Survey of India, vol. xxxviii. "The Kangra Earthquake of April 4, 1905." By C. S. Middlemiss. Pp. x+409+xxi+30 plates. (Calcutta: Geological Survey; London: Kegan Paul and Co., Ltd.; Berlin: Friedländer and Sohn, 1910.) Price Rs. 5.

[1] NATURE, March 1, 1906 (vol. lxxiii., p. 418).

strain at two places where the strain was specially great owing to resistances to the well-established forward march of the overthrusting foot of the Himalayan range.

All this is perfectly clearly put, the argument is logically arranged, and the conclusion is perfectly orthodox; but yet we must confess that in reading Mr. Middlemiss's description we were struck by many indications of the absence of direct connection between earthquake and geological structure. The principal focus of maximum intensity extends from the sub-Himalayan area across the great boundary fault, which is by far the grandest structural feature of the region; and the subsidiary focus in the Dehra Dun shows no tendency to a concentration of violence along any particular line or connection with any known structural feature, and from this area some observations are recorded which seem to be of importance so far as the origin of earthquakes is concerned. An old line of levelling from Saharanpur to Mussooree was gone over again after the earthquake with the result that although the relative levels of the extremities of the line were unchanged, it was found that the intervening bench marks in the Dehra Dun and the Siwaliks showed an elevation of from 4 to 5 inches. As no alteration in the relative level of Dehra Dun and Mussooree had been noticed when this section was re-levelled in May, 1904, it is practically certain that the change took place at the time of the earthquake. Now if the results are examined it may be noticed that elevation was not confined to one station, as might be expected had it been due to shifting of the opposite sides of a fault, but is rather a general bulging upwards, such as might be produced by a sudden increase in volume of the material underlying the region of greater violence of shock.

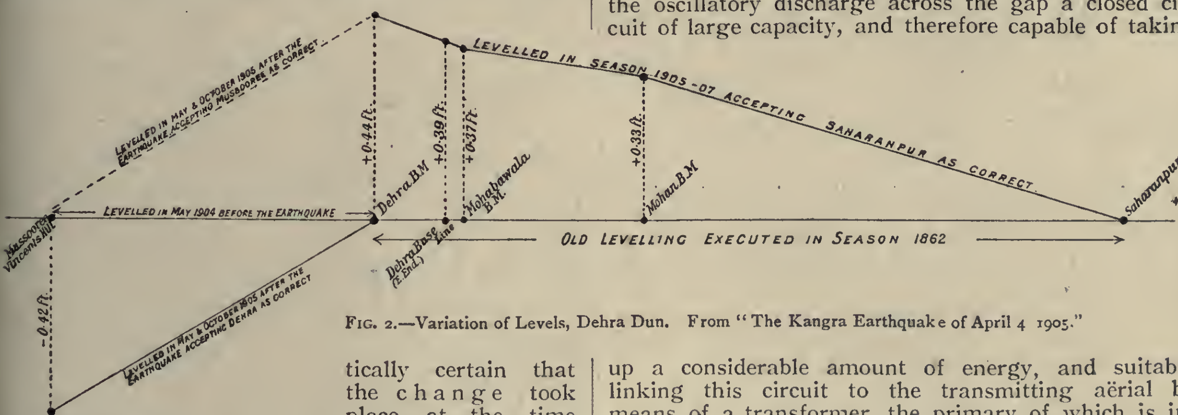


Fig. 2.—Variation of Levels, Dehra Dun. From "The Kangra Earthquake of April 4 1905."

These, however, are matters of inference and interpretation, and whatever may be the ultimate trend of thought as concerns them, the memoir under review will stand as an important contribution to knowledge which will have to be studied and reckoned with by all who attempt to deal with the vexed question of the nature and origin of earthquakes.

WIRELESS TELEGRAPHY SYSTEMS.

The action brought by Mr. Marconi and Marconi's Wireless Telegraph Co., Ltd., against the British Radio-Telegraph and Telephone Co., Ltd., for infringement of patent No. 7777 of 1900, concerning improvements in apparatus for wireless telegraphy, has been concluded, and Mr. Justice Parker delivered judgment on February 21 in favour of the plaintiffs.

The patent in question refers to an arrangement of the sending and receiving circuits in such a manner as to make telegraphy possible over increased distances by means of spark methods. In the methods in which spark-dischargers are used, a spark is caused to bridge the gap by the application of a direct-current or alternating-current supply, and it is arranged that the discharge thus produced should form part of a circuit in which high-frequency oscillations may be set up. This circuit must contain a capacity and inductance, and the charge and discharge of the capacity taking place through it will be of an oscillatory nature if the resistance of the cricuit be not greater than $\sqrt{\frac{4L}{K}}$, where L and K represent the inductance and capacity of the circuit. When the resistance is greater than this value, the discharge is not of an oscillatory nature, and is therefore unsuitable for the production of waves for wireless telegraphy.

In early methods of working the gap was placed directly between the aërial and an earth-plate, and the discharge produced by connecting an induction coil across the gap. The oscillating circuit consisted of the spark-gap and the capacity and inductance of the aërial, and the energy that could be radiated was small owing to the very small capacity of the aërial. The receiving circuit consisted of an aërial connected to earth through a coherer, which formed part of a relay circuit actuating a Morse printing instrument.

The improvement constituting the subject-matter of the patent under discussion consists in providing for the oscillatory discharge across the gap a closed circuit of large capacity, and therefore capable of taking up a considerable amount of energy, and suitably linking this circuit to the transmitting aërial by means of a transformer, the primary of which is inserted in the closed circuit, and the secondary of which is connected in the aërial. By this means oscillations of great energy are able to be set up in the closed circuit, and if the aërial circuit be tuned to have the same frequency of oscillation as this circuit, and be loosely coupled to it by the transformer, long trains of waves of a single frequency will be radiated by the aërial, which is, in virtue of its open circuit, a good radiator of the energy gradually supplied to it by the good oscillator formed by the closed circuit.

A similar idea underlies the arrangement adopted for the receiving circuit, in which a good absorber consisting of an open circuit containing the aërial is linked by a transformer to a poor radiator, and consequently a good accumulator of energy consisting of a closed circuit.

The apparatus of the British Radio-Telegraph Co. is substantially similar to that described above, with the exception that the oscillating and radiating circuits at the transmitting end, and the receiving and storing circuits at the receiving end, are connected by means of a single-coil transformer or auto-transformer instead of a two-coil transformer, as is used in the Marconi arrangement.

A considerable portion of the proceedings was occupied in the discussion whether the use of a single-coil transformer in the place of a two-coil transformer constituted an infringement or not, and the judgment

upheld the contention of the Marconi Co. that the two kinds of transformers are electrically equivalent, and that the apparatus of the defendants was an infringement of their patent.

The defence disputed the validify of the contested patent, and attempted to prove anticipation, basing the contentions principally on the patents granted to Sir Oliver Lodge and Prof. Braun. It is indeed a fact that the apparatus described by both these inventors contain examples of inductive couplings between the aërial and the oscillation-generating circuits, but it was successfully argued that neither of them had claimed the special kind of loose coupling or the tuning of the circuits that are essential to the satisfactory working of the Marconi system, and are fully set out in the Marconi patent specification. Other scientific investigators were mentioned, such as Henry, Tesla, and Elihu Thomson, who have employed coupled circuits, but their use of a transformer merely to raise the potential of the electrical oscillations produced by the discharge of Leyden jars was not able to be proved to constitute an anticipation or prior user of the essential features of the patent that has now been upheld.

The decision in this case has created a situation the outcome of which it is difficult to foresee, but there is no doubt that a number of companies now working systems similar to that of the Marconi Company will need to close their operations or to change their systems. This will have a marked effect on the grouping of wireless telegraph companies that is being carried out in England and on the Continent at the present time.

A. J. MAKOWER.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. H. T. Barnes, Prof. A. J. Brown, Prof. J. B. Cohen, Prof. W. E. Dixon, Prof. F. G. Donnan, Major E. H. Hills, Dr. W. H. Lang, Prof. J. B. Leathes, Prof. E. A. Minchin, Prof. R. Muir, Mr. R. D. Oldham, Mr. R. I. Pocock, Prof. A. W. Porter, Mr. H. W. Richmond, and Mr. G. G. Stoney.

UNDER the auspices of the Advisory Committee for the Investigation of Plague in India, Dr. G. F. Petrie, of the Lister Institute, left London on February 20 *en route* for Harbin, where he intends to prosecute investigations into the spread of pneumonic plague in Manchuria. Opportunities for extended research into this highly contagious and extremely fatal form of plague infection have only rarely presented themselves, and as all available information points to the fact that the disease in Manchuria is almost exclusively of the pneumonic type, it is hoped that Dr. Petrie's investigations may shed some light on the factors which determine the incidence and spread of this particular variety. With matters of administration and sanitary measures Dr. Petrie will not be concerned. As one of the bacteriological experts whose work in Bombay (1905–7) proved conclusively the *rôle* played by the rat flea in transmitting bubonic plague from rat to man, Dr. Petrie obtained an intimate acquaintance with the disease in its epidemiological and bacteriological aspects, and recently he has been engaged, at the request of the Local Government Board, in determining the extent of the rat infection in Suffolk. The precise form which Dr. Petrie's investigations will assume in Manchuria cannot be determined until the local conditions prevailing in the plague-stricken area and the facilities available for scientific inquiry are known. Dr. Reginald Farrar, one of the medical inspectors of the Local Government Board, is also on his way to Harbin as the British representative on the International Plague Commission convened at the request of the Chinese Government.

IN the Prussian Diet of February 18, Prof. Kirchner, a well-known epidemiologist and administrator in the service of the Ministry of the Interior, is reported to have said that, during the last few weeks, three cases of plague had occurred in London, the infection being conveyed by ship-rats. This statement has been officially denied, and it is probable that Prof. Kirchner had in mind the two isolated cases of plague which occurred in ships on the Thames four months ago (see *The Times*, October 14 and 15, 1910). With the exception of a few imported cases on ships arriving at the docks, no cases of plague have been reported in London since the year 1679. An interesting account of such imported cases in recent years is to be found in *The Times* of February 20. With regard to rat infection, three rats which had probably escaped from a ship were examined at the London Docks in November last, and two of them were found to be suffering from plague, but at present there is no evidence of the existence of a plague epizootic among rats in the London Docks area. The destruction of rats, which was instituted in 1908 owing to the existence among them of a disease declared to be a mild form of plague, is still carried out at the London Docks, and careful precautions are being taken to prevent rats in ships from infected ports from escaping ashore, and possibly initiating an epizootic among the shore rats. Large numbers of cats are also maintained in the various warehouses and sheds.

THE death of the well-known Indian pteridologist, Col. R. H. Beddome, in his eighty-first year, took place on February 23 at his residence, "Sispara," West Hill, Putney. Educated at Charterhouse, Col. Beddome entered the Indian Army in 1848, and became quartermaster and interpreter of the 42nd Madras Infantry in 1856. A keen student of natural history, whose scientific tastes were well known, he was selected to act as principal assistant to the conservator in the newly organised Madras forest department in 1857; three years later he became conservator himself, and held this position until his retirement in 1882. His transfer to the Forest Department led him to give especial attention to botany, more particularly with regard to forest needs, and led to the preparation of a work on "The Trees of the Madras Presidency," published in 1863, followed by an excellent "Flora Sylvatica" of southern India, two quarto volumes, with plates and descriptions of 400 species, published between 1869 and 1874. A professional "Report upon the Nelambur Teak Plantations" was published by Government in 1878. His leisure, however, was given to the systematic study of other groups of plants, one of his earliest papers, published in 1859, being an interesting attempt to reduce to order the south Indian species of the difficult genus Impatiens. In 1863 appeared Beddome's important work "The Ferns of the Madras Presidency," a quarto volume of descriptions and plates which at once stamped him as an authority of this family. The issue between 1865 and 1870 of a similar work on "The Ferns of British India," with descriptions and figures of species not dealt with in the earlier work and the Supplement to that work issued in 1876, only served to confirm the position of authority he had been by common consent accorded. But ferns did not entirely absorb his attention, for between 1869 and 1874 Col. Beddome issued a volume of "Icones Plantarum," with descriptions and figures of 300 interesting species from southern India and Ceylon. Before he left India, he placed students of ferns under a further obliga-

tion by the preparation of "Handbook of the Ferns of British India," embodying his rich store of information regarding the family, illustrated by reduced copies of the illustrations to his own earlier and more costly works. This handbook appeared in 1883, immediately after his retirement.

THE King of the Belgians has made a donation of 500*l.* to the funds of the Liverpool School of Tropical Medicine.

M. EUGÈNE TISSERAND has been elected a member of the Paris Academy of Sciences in succession to the late Prof. Tannery.

BY his will, M. Auguste Loutreuil, the son of a small French farmer, who later became a wealthy contractor in Russia, has left 284,000*l.* towards the promotion of science in France. The University of Paris will receive 100,000*l.*, the Academy of Sciences 140,000*l.*, the Pasteur Institute 4000*l.*, and a sum of 40,000*l.* is to provide a fund for scientific research.

DR. BASHFORD DEAN, professor of vertebrate zoology at Columbia University, who was curator of the department of ichthyology and herpetology of the American Museum of Natural History from 1903 until last year, when he resigned, has accepted an invitation to resume that post.

PROF. F. B. LOOMIS, of Amherst College, Mass., will start early in July, accompanied by three of his students, on an expedition to Patagonia. Their principal purpose will be to collect fossils and study the geological problems of the country between the Santa Cruz and Deseado rivers. The expenses of the expedition will be met by the "class" of 1896.

AMERICA has lost one of her pioneers in physical training by the death of Dr. Edward Hitchcock, in his eighty-third year. Since 1861 he had been professor of hygiene and physical education at Amherst College, which gave him at the same time a general oversight of the health and exercise of its students. His work in that capacity had a wide influence, and within twenty years after his appointment fifty American colleges had organised departments of hygiene on similar lines. Dr. Hitchcock was the author of text-books on physiology and anatomy.

A BILL to prohibit the sale, hire, or exchange of the plumage and skins of certain wild birds was read a first time in the House of Commons on February 22. In introducing the measure, Mr. Alden said the Bill had been before a Select Committee of the House of Lords and had been approved unanimously, while in the last Parliament there were only two members who were against it. Twenty-one of our colonies are in favour of the Bill, and possess powers to prevent the export of the plumage of rare birds.

WE learn from *The British Medical Journal* that a lectureship has been established by the National Health Society as a memorial to the late Lady Priestley, who was one of the original members of the committee when the society was started some thirty years ago, and attended all the meetings until within a few months of her death. Three lectures have been arranged for March, the first by Sir E. Ray Lankester on living microbes, the second by Sir Almroth Wright on bacteriology and hygiene, and the third by Mr. Stephen Paget on Pasteur and his work.

A NEW biology and botany section has been added to the Bristol Museum. The new room has been provided by Lady Smyth, and is to be known as the "Dame Emily Smyth Room." The room has been made especially strong in its exposition of the kitchen-garden, fruit-tree, and agricultural pests of the west of England. At the opening ceremony on February 21, the curator, Mr. H. Bolton, said the authorities look forward to the economic biology department becoming practically useful to the farmer, to those who possess orchards, to the small growers, and to every man who loves plants and flowers and cultivates them for his pleasure or profit.

THE summary of the weather for the first eight weeks of the present year, issued by the Meteorological Office, shows that the rainfall for the period was deficient over the entire kingdom except in the north and west of Scotland. The greatest deficiency in any district is 2·83 inches in the south of Ireland, and this is closely followed by 2·74 inches in the south-west of England and 2·53 inches in the Channel Islands. In the Midland counties the deficiency for the two months amounts to 1·81 inches, and in the south-east of England to 1·56 inches. The largest aggregate rainfall for the period in any district is 10·80 inches in the north of Scotland, and the least 1·95 inches in the Midland counties. The rainy days range from 39 in the north of Scotland to 22 in the Midland counties. The mean temperature and the duration of bright sunshine are both in fair agreement with the average. At Greenwich the mean temperature for January was slightly below the normal, and in February it was above the normal to about the same extent, so that the mean of the two months is in absolute agreement with average conditions. Frost occurred in the shade at Greenwich on eight nights, both in January and February. Gales and strong winds were experienced frequently during February over the entire country, and there was a marked preponderance of westerly winds.

BEFORE the Royal Geographical Society on February 27 Dr. W. T. Grenfell, C.M.G., described the most important features of Labrador, a land still hardly known beyond its borders. The Vinland of the Norse sagas, its resources are great, but the polar current dominates its climate, and its southern latitude provides it with a short summer, which has not the continuous sunshine of Alaska and other places farther north. Cold soil and the dryness of the winds cause the stunted nature of many plants, a larch at the south end of Labrador being but 9 inches high and three-eighths of an inch in diameter, though it showed thirty-two years' growth. Except by Prof. R. A. Daly and Mr. A. P. Low, no serious geological investigation has been undertaken; mineral deposits seem to be abundant, but such prospectors and others as have visited the region have worked but for short periods. On the evidence of beaches and glacial deposits, Labrador was said to be rising, possibly as much as 15 or 20 inches per century according to some estimates. The coasts are still but imperfectly charted, and parts are dangerous, but harbourage is plentiful, and the numerous islands and the narrow waterways furnish many facilities for coastal navigation.

IN a former issue of NATURE it was announced that, in connection with the Royal International Horticultural Exhibition to be held in the grounds of Chelsea Hospital in May, 1912, there is to be a scientific section, and a congress will be arranged for the discussion of horticultural education and matters of scientific interest. A special committee has been appointed to look after these subjects, and the first meeting has been held. The chairman of this committee is the Rt. Hon. A. H. Dyke Acland, P.C., and Mr. F. J. Chittenden will act as honorary secretary. The members include Mr. E. A.

Bowles, chairman of the Royal Horticultural Society's scientific committee, Prof. W. Bateson, F.R.S., Prof. Bayley Balfour, F.R.S., Sir Thomas Elliott, K.C.B., Mr. Anderson Graham, Prof. Bretland Farmer, F.R.S., Mr. George Gordon, Mr. H. Rider Haggard, Sir Everard im Thurn, K.C.M.G., Dr. D. Jackson, Dr. F. Keeble, Mr. Donald MacDonald, Mr. W. Marshall, Mr. F. W. Moore, Mr. Spencer Pickering, F.R.S., Lieut.-Colonel D. Prain, C.I.E., F.R.S., Dr. A. B. Rendle, Mr. T. A. H. Rivers, Mr. A. G. L. Rogers, Prof. E. S. Salmon, Mr. A. W. Sutton, Prof. Somerville, Mr. H. J. Veitch, Prof. S. H. Vines, F.R.S., and the Rev. W. Wilks. Whilst the exhibition will be one of the chief spectacular attractions of the London season of 1912, the unique opportunities afforded by the presence of experts from every country will be utilised to the fullest extent for the advancement of horticultural science.

The Colonial Office announces that, to further the work of the African Entomological Research Committee, Mr. Andrew Carnegie has placed at the disposal of the committee a sum of 1000*l.* a year for three years to defray the cost of sending a few suitably qualified young men to the United States to study the practical applications of entomology. Three of these Carnegie scholars have been selected, and two are now at work in the States. The fact that Dr. L. O. Howard, chief of the Bureau of Entomology at Washington, is interesting himself, is a guarantee that all facilities will be given to the scholars, and the scheme will be of great value to British administration by providing well-trained entomologists for employment by the different Colonial Governments. The research committee was appointed in June, 1909, to promote the study of the insects which spread disease in Africa. Lord Cromer is its president, and it includes eminent authorities on entomology and tropical medicine. The scheme has been taken up by the African colonies and protectorates, and the material already received at the committee's office in the Natural History Museum at South Kensington has increased our knowledge of the insect pests of Africa. The collections of insects, after being identified and recorded, are being distributed to the schools of tropical medicine, universities, museums, or other institutions where they are likely to be of value. Further particulars may be obtained from the secretary of the committee, Mr. Guy Marshall, British Museum (Natural History), South Kensington, London.

A Bill to promote the earlier use of daylight in certain months yearly, and for other purposes relating thereto, has been introduced into the House of Commons by Mr. Robert Pearce. The chief clauses of the measure are as follows:—(1) From 2 o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of the third Sunday in April in each year, until 2 o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of the third Sunday in September in each year, the local time shall be in the case of Great Britain one hour in advance of Greenwich mean time, and in the case of Ireland one hour in advance of Dublin mean time, and from 2 o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of the third Sunday in September in each year until 2 o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of the third Sunday in April in each year, the local time shall be in the case of Great Britain the same as Greenwich mean time and in the case of Ireland the same as Dublin mean time. (3) Greenwich mean time as used for the purposes of astronomy and navigation shall not be affected by this Act. (4) This Act shall apply to the United Kingdom of Great Britain and Ireland, and may be cited as the Summer Season Time (Great Britain and Ireland) Act, 1911. We have on several occasions expressed the opinion that the changes contemplated by the Bill are unnecessary and undesirable, and we trust that the measure will meet the same fate as that of previous attempts at so-called "daylight saving."

The London County Council is doing good service to anthropology by developing the Horniman Museum at Forest Hill. It has now published, at a nominal price, under the title of "A Handbook to the Stages in the Evolution of the Domestic Arts," a useful introduction to the science of technology, prepared by the curator, Dr. H. S. Harrison, under the advice of Dr. A. C. Haddon. Curators of provincial museums might well consider the advisability of adapting this to the collections under their charge.

In the tenth number, vol. ii., of the Memoirs of the Asiatic Society of Bengal, recently issued, Mr. H. H. Hayden, of the Geological Survey of India, under the title of "Notes on some Monuments of Afghanistan," describes, first, some of the Buddhist Topes near Kábul, and has been able to correct a mistake of James Fergusson in his "History of Indian Architecture," who confuses the Munár-i-Surkh with the Munár-i-Chakri. It is regrettable to learn that the platform of the latter is in so ruinous a condition that, if immediate action be not taken, this interesting monument will inevitably fall. It may be hoped that the Viceroy may be able to put some pressure upon the Afghan authorities in order to avert this catastrophe. He also gives an interesting series of photographs of the celebrated Buddhist carvings at Bámián, and is able to give some new information about them. Occasion was also taken to photograph the tomb of the Emperor Bábar, who died at Agra in A.D. 1530 and was buried at Kábul. It is now possible, for the first time, to give in Persian and English the inscription on his tomb.

In a sixth report on research work, Dr. A. C. Houston, director of water examination, Metropolitan Water Board, gives details of an investigation on the comparative vitality of "uncultivated" and "cultivated" typhoid bacilli in artificially infected samples of raw river water, with special reference to the question of storage. In a previous investigation on the same subject (see Nature, vol. lxxviii., 1908, p. 377) it was found that in raw river water inoculated with ordinary laboratory cultures of the typhoid bacillus, in one week there was a percentage reduction in the number of bacilli of 99·9, but that a resistant minority of bacilli persisted up to nine weeks in the inoculated water. In the present work the raw river water (5 litres, kept in a partially stoppered bottle in a cellar) was inoculated with typhoid bacilli obtained by centrifugalising the infected urine of a carrier case which had come under the observation of Prof. McWeeney, of Dublin. In this way typhoid bacilli derived directly from the patient, without artificial culture, were added to the water, as would be the case in the natural infection of a water supply. At the end of one week after inoculation, examination showed that the initial number of 770,000 typhoid bacilli per c.c. of water was reduced to 4 per c.c.—a reduction of more than 99·99 per cent. Five subsequent examinations made from the fourteenth to the thirty-fourth day after the commencement of the experiment failed to isolate the typhoid bacillus from 100 c.c. of

the water. A second similar experiment gave corroborative results. In addition, Dr. Houston on several occasions drank half a pint of the water after the twenty-third day without ill effect! In another experiment water was inoculated with the typhoid bacillus derived from the same source, but cultivated for several generations on artificial media. The organism in this case was isolated up to the sixth week after inoculation into the water. The conclusion, therefore, is that "uncultivated" typhoid bacilli rapidly perish in raw river water, and that even a week's storage of raw river water is an enormous protection against typhoid infection from such a source.

IN the *Museums Journal* for January Dr. R. F. Scharff, of the National Museum of Ireland, Dublin, describes a dry system of macerating bones for use as exhibits. Formerly this was effected in water tanks, which proved so offensive on sanitary grounds that it was necessary to discontinue their use. Dr. Scharff has now discovered that the object can be satisfactorily attained by covering the bones with dry sea-sand, the bacteria almost wholly performing the work of maceration. Small skeletons are enclosed in boxes filled with sand, and the task of rearranging the bones when they are clean is thus greatly facilitated.

IN *Novitates Zoologicae* for December, 1910, vol. xvii., p. 445, pls. viii., ix., the Hon. Walter Rothschild gives coloured plates of the sea-elephants of Guadaloupe Island and the Falklands. The former is identified with the typical Juan Fernandez sea-elephant described by Linnæus as *Phoca leonina*, which appears to make periodical migrations from that island to Guadaloupe and back. Despite the much greater length of the proboscis in the males of the Juan Fernandez as compared with the Falkland animal, the author points out that other forms indicate a transition in this respect between the extremes, and he therefore proposes to regard all the local forms as races of a single species. This is, perhaps, the most satisfactory conclusion of a problem which has given rise to a considerable amount of discussion and confusion.

THE former existence of one imported giant land tortoise in Ceylon has long been known to naturalists, but it is remarkable that it should have been left to a casual correspondent of an English journal to supply evidence of the occurrence of a second. The first specimen, according to a letter from Mr. Pearson, director of the Colombo Museum, in *Spolia Zeylanica* for December, 1910, was found in Colombo when Ceylon was first occupied by the British in 1796. It was then living in the grounds of a villa called Uplands, in Mutwall, near Colombo; in 1894 it was removed to the Victoria Park, where it survived only a week. It is now preserved in the Colombo Museum, and is identified by Mr. Pearson with *Testudo gigantea* of Aldabra. The length of the shell is 40 inches. In *Country Life* of July 9, 1910, appeared a photograph of a giant tortoise living at Matara, near Galle, taken by Mr. Stanley Mylius, which is reproduced by Mr. Lydekker in an article on giant tortoises in *Science Progress* for October, 1910. That specimen, which is referred to *T. gigantea*, the author thought might be distinct from the Colombo tortoise, and that it is so is indicated at the close of Mr. Pearson's letter. In Mr. Lydekker's article the length of the shell is given as 53½ inches, and it may be that this refers to the Matara specimen, in regard to which Mr. Pearson hopes to obtain further information.

RECENT observations by Prof. S. O. Mast (*Journ. Exper. Zool.*, vol. ix., No. 2) on the reactions of *Amoeba proteus* to light show that a sudden and sharp increase of light intensity causes retardation or cessation of movement; if the intensity be maintained constant for a few moments, the movements of the Amœba begin again. A gradual increase in intensity produces no response, so that the reaction to light depends primarily on the rate of change of intensity. Blue rays (430–490 $\mu\mu$) are nearly as efficient as white light in producing reactions, but violet, green, yellow, and red produce only slight effects. The author suggests that, as other organisms respond most definitely to light of other colours—violet, green, yellow, or red—it is probable that different photo-chemical changes are associated with the reactions to light in different organisms. Prof. Mast has given, in the *Psychological Bulletin*, vol. vii., pp. 267–80, an abstract of literature, of the year 1909, on the behaviour of lower organisms, including a summary of the discussion on the subject of tropisms by Messrs. Bohn, Loeb, Jennings, and Darwin at the International Congress of Psychology, held at Geneva.

THE *Zentralblatt für Physiologie* (Bd. xxiv., No. 17) is almost entirely occupied by an excellent summary, extending over fifty-two closely printed pages, of the numerous papers read before the eighth International Congress of Physiologists, held at Vienna on September 27–30 last. The number also contains three short original contributions. In the first of these Fr. Kutscher gives the results of his examination of the aqueous extract of mushrooms, which he found to contain arginin, cholin, betain, and a hitherto unknown base, the formula of which is similar to that of histidin, with the addition of three methyl groups; but the organic bases form only a very small portion of the extract, the physiological action of which depends on other substances present. T. Kinoshita concludes, after a series of analyses, that normal, fresh human urine contains only a trace of trimethylamine, but, on standing, this substance is formed during some fermentative process. E. Berlin describes a new synthesis of γ-homocholin, starting from β-aminopropylalcohol. Issued with this part of the *Zentralblatt* is a further portion (pp. 177–317) of the Bibliographia Physiologica (third series, vol. v., Nos. 3, 4), prepared by the Concilium Bibliographicum in Zürich, which, with the two preceding parts, contains the titles of papers published in 1909. These are arranged in the usual sections, according to the subjects of which they treat, and there is, at the end, an author-index to the contents of the whole volume.

To the Transactions and Proceedings of the Perthshire Society of Natural Science for 1909–10 (vol. v., part ii.) Mr. R. Dow contributes a life of David Douglas, of Scone, who introduced into Great Britain no fewer than seven species of American conifers, among which *Abietia Douglasi*, although originally discovered in Nutka Sound during Vancouver's voyage round the world, was named in his honour. Douglas was born at Old Scone in 1799, and, after being employed at the Glasgow Botanical Gardens, started in 1824 on a botanical expedition to the banks of the Columbia River and the neighbouring districts. Thence he travelled southwards to California in 1831, and two years later left America for the Sandwich Islands, where he died, as the result of an accident, in 1834. In 1847 a monument was erected to his memory by public subscription in Scone churchyard. Although they were not introduced into Great Britain until considerably later, *Sequoia sempervirens* and *S. gigantea* (the so-called Wellingtonia) were practically discovered by Douglas, the notices of them by Archibald Menzies in 1795 and 1796 being very imperfect.

In the February number of *Petermanns Mitteilungen*, with which *Globus* is now incorporated, Dr. V. Paschinger discusses the results of an investigation of the snowline in different regions. The present article is but a summary, since the full discussion is to be published later, but the main results are here given. The principal determining factor he considers to be temperature, except in regions where the snowfall is exceptionally heavy, when precipitation is more influential climatically. For a certain number of places he has been able to compare the position of the snowline in different years, and finds that generally in the northern hemisphere at the beginning of the 'seventies it occupied a position of minimum altitude, and has reached a maximum level since 1890.

The results of Dr. K. Sapper's journey in the island of South Mecklenburg of the Bismarck Archipelago, undertaken in 1908 for the German Colonial Office, are published in the third Erganzungsheft of the *Mitteilungen aus den deutschen Schutzgebieten*. The topography and physical conditions of the island and others near it were principally studied, but the climate, the densely wooded nature of the region, and the short time available only admitted of a rapid reconnaissance, while the botany and zoology could be scarcely attempted. Using the charts of the German Admiralty as a basis, compass and aneroid were used to determine the land features, which are given in orographically coloured maps; but these, for the above reasons, can only represent the general relief of the island without claiming accuracy of detail. Geological investigation was rendered difficult by the vegetation, and gravel in the stream-beds furnished specimens of rocks which were not otherwise met with. Oligocene limestones and glauconitic sandstones were found; but most of the sedimentary rocks, consisting of sandstones, limestones, tuffs, and clays, are considered to be Pleistocene. Diorite, syenite, gabbro, and granite were met with, but a far larger area is occupied by the younger eruptive rocks, principally andesite.

In Nature, vol. lxxix., p. 234, M. Paul Macey's descriptions of subterranean waterways in Indo-China were referred to. He now supplements his paper in *Spelunca* by an illustrated account of the "Tunnels naturels du Laos" in *La Nature*, 1911, p. 102. We are surprised that he gives no reference to his previous paper, where his adventures and explorations underground were described so cheerfully.

Herr H. Habenicht, of Gotha, has circulated a pamphlet, "als Manuskript gedruckt," entitled "Spuren der Eiszeiten in Norddeutschland und Versuch ihrer Deutung" (Gotha: Andreas Perthes, 1910). It is accompanied by an excellent map in colours. The author directs attention to the absence of true terminal moraines along the margin of the northern glacial drift in its most southerly extension. The deposits in this region, unlike such moraines, show curved forms that are convex towards the north, while their terminations reach down into the valleys that notch the Thüringian, Saxon, and Sudetic border. The author believes that the facts require the occurrence of a great flood between two ice-ages, whereby the deposits of the older ice-age were swept into their present positions against the southern hills. An interglacial diluvium was thus deposited; but an older one also exists. Loess was formed in pre-glacial times during an epoch of continental elevation, and of consequent dryness through remoteness from the sea. A catastrophic falling in of the surface swept the sea water over this, and led to the formation of an old diluvium. Then followed the first ice-invasion, a second uplift and a steppe epoch, and a second general sinking and "Sturmflut des Weltmeeres" The consequent rains brought on the second ice-age, when the glaciers only reached the Baltic region. The mixture of the remains of Arctic and tropical or steppe animals is attributed to flood-action. It is clear that Buckland's early views have lived on, in spite of the conversion of their author.

In a paper contributed to the Spanish Institute of Civil Engineers (Barcelona: Guinart et Pujolar), Dr. Paulino Castells Vidal describes an ingenious balance for finding the real roots of an algebraic or similar equation. This apparatus consists of a horizontal shaft on which are attached cams in the form of equiangular spirals or similar curves, from which may be suspended weights representing the coefficients of powers of x in an algebraic equation; on the other hand, the arms of the levers formed by the cams are for different values of the angular coordinate proportional to the values of 1, x, x^2, for different values of x. Consequently, when the apparatus has come into a position of equilibrium, the pointer attached to the shaft at once gives a real root of an algebraic equation the coefficients of which are the weights of the loads suspended from the cams.

We have received the reprint of a paper, by Mr. Cyril F. Lan-Davis, read before the Optical Society last December, and reprinted from *The Optician and Photographic Trade Journal*, dealing with the theory of the iris diaphragm. Hitherto these useful optical accessories have been mainly designed by trial, with the result that in many cases it has been stated to be impossible to give sufficiently large ranges of aperture for the requirements of modern lenses and their fittings. The author now shows how the problem can be treated by the methods of elementary geometry, and the conditions for maximum range of aperture, as well as for other important requisites, such as a long scale with equal divisions, can be made the subjects of exact calculation. Neglecting the dimensions of the pins which carry the leaves, it is shown that the maximum aperture obtainable is 0·823 of the diameter of the diaphragm itself, and that for this twenty-five leaves are required. This is a good example of a problem where a little mathematics may save a great deal of random experimenting.

Intending purchasers of microscopes and microscopic apparatus will be well advised to consult the list issued by Messrs. R. Winkel, of Göttingen, obtainable from their London agents, Messrs. H. F. Angus and Co., 83 Wigmore Street. Attention is specially directed to the microscope stand No. 1*d*, the fluoride objectives that originated in Göttingen, and an excellent series of complanatic eyepieces giving a particularly flat field. The general workmanship and finish compare favourably with those of other leading makers. The object marker is a new piece of apparatus similar in shape to an objective, and in place of which it is inserted, for marking a circle round any desired spot on a slide. The type supplied for marking covered objects is provided with a diamond point set in a mount that can be rotated.

In the September (1910) number of the Journal of the Franklin Institute, Philadelphia, Mr. J. H. Dellinger, of the Bureau of Standards, made a preliminary announcement of an interesting relation he had discovered between the electrical resistivity, the coefficient of increase of the resistivity with temperature, and the density of specimens of copper of all makes submitted to the bureau for test. According to Mr. Dellinger, the product of the three quantities mentioned is constant for all specimens of copper

at 20° C. This result, according to a paper by Dr. S. Lindeck, of the Reichsanstalt, which appears in the January number of the *Verhandlungen der Deutschen Physikalischen Gesellschaft*, is confirmed and extended to very impure coppers and to aluminium and iron by the tests made at the Reichsanstalt during the past five years.

ACCORDING to notices to hand from the Société française de Physique, the *Journal de Physique* is in future to be published by the society, and the three-monthly *Bulletin des Séances* is no longer to be issued. The increased cost is to be met by an increase of the subscriptions to 25 francs for resident and 20 francs for non-resident members. The first issue of the *Journal de Physique* under the new conditions, which appeared early in January, contains a *résumé* by Messrs. Cotton and Mouton of their work on the magnetic double refraction of pure liquids, to which we referred in these columns in November last. The abstracts of papers which have appeared in other periodicals occupy about twenty pages, and seem thoroughly good, but as they nearly all relate to papers published in the early months of 1909, it is evident that much requires to be done before the journal can claim that it is placing the present state of the various branches of physical science before its readers.

WITH reference to an offer recently made to the Calcutta University by the Hon. the Mahárája of Cassimbazar of 20,000 rupees, for the purpose of editing and translating Sanskrit texts dealing with astronomy and mathematics, Dr. G. Thibaut stated, at the meeting of the Asiatic Society of Bengal on February 1, that he will shortly explain the present state of knowledge of Indian astronomy and mathematics, and point out what remains to be done in the way of publishing and translating. In this connection he will deal shortly with the following points:—the successive stages of the development of astronomy and mathematics in India; the characteristic features of each stage; the question whether the astronomical and mathematical knowledge possessed by the ancient Hindus originated in India or was borrowed in part or in its entirety from some other nations (Greeks or Babylonians); the use which has been made of certain data of an astronomical nature met with in the *Veda*, for determining the age of the *Veda* or of Indo-Aryan civilisation.

COMMENTING on the *Waratah* wreck inquiry, *Engineering* for February 24 states that the most important point which emerges from the finding of the Court appointed by the Board of Trade is the recommendation that a committee of experts should be appointed to arrive at some conclusion concerning the minimum stability requirements of different types of vessels at sea. Curves showing these requirements might be utilised for preparing rules for the guidance of shipowners in the stowage of cargo in each ship with greater precision than is now possible. Our contemporary states that it has been the practice with experienced builders, among whom should be classed the builders of the *Waratah*, to supply owners with full information regarding the stability of the ship under all conditions of loading, and with instructions as to the disposition of the ballast, in order to ensure the continuance of satisfactory conditions. But there is no certainty as to whether or not these conditions are scrupulously fulfilled by the officers responsible for the ship. The proposal to institute a committee for the formulation of rules is satisfactory in itself, but something more is required in order to ensure that the rules will be carried out most carefully.

A CONTRIBUTION from the Jefferson Physical Laboratory, Harvard University, appears in the Proceedings of the American Academy of Arts and Sciences for January, giving an account of some experiments on the action of mercury on steel at high pressures. Amagat in 1893 described a case in which mercury was forced by a pressure of 3000 atmospheres in a fine spray through 8 cm. of cast steel, in which no flaw could be afterwards detected with the microscope. In the experiments now described, twelve similar test cylinders were cut from a bar of Krupp's special chrome nickel steel. Six of these were tested under mercury pressure, and the others were tested with a glycerin and water mixture, with ether, and also CS_2. Five of the cylinders tested with mercury burst at pressures from 3000 to 4750 kilograms per square cm.; one burst at 10,250 kilograms per square cm. None of the cylinders tested with other fluids burst, even under pressures of 24,000 kilograms per square cm. Soft steel cylinders show this effect hardly at all, owing to the interference of the lower yield point of the material. Examination of the fracture seems to establish the fact that the lower strength of hard steel cylinders under mercury pressure is owing to amalgamation. Amalgamation once started, it spreads with great rapidity throughout the metal. Two causes hasten the rapidity of the action: one is the natural affinity of mercury and steel, the other is the straining action of the pressure, tending to open the pores. The latter view is strongly supported by the fact that, in the fractures, amalgamation was observed to be most rapid in the direction in which the pores were most distended.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MARCH:—

March 2. 5h. 58m. Venus in conjunction with the Moon (Venus 2° 20′ N.).
4. 10h. 22m. Saturn in conjunction with the Moon (Saturn 1° 39′ S.).
9. 17h. 23m. Neptune in conjunction with the Moon (Neptune 5° 22′ S.).
10. 21h. 40m. Mars in conjunction with Uranus (Mars, 0° 23′ S.).
18. 14h. 8m. Jupiter in conjunction with the Moon (Jupiter 1° 47′ N.).
20. 1h. 0m. Mercury in superior conjunction with the Sun.
21. 5h. 45m. Sun enters sign of Aries. Spring equinox.
24. 16h. 49m. Uranus in conjunction with the Moon (Uranus 4° 39′ N.).
25. 12h. 3m. Mars in conjunction with the Moon (Mars 4° 15′ N.).
28. 17h. 50m. Venus in conjunction with Saturn (Venus 2° 25′ N.).
30. 12h. Neptune stationary.
,, 18h. 51m. Mercury in conjunction with the Moon (Mercury 2° 22′ N.).
31. 23h. 15m. Saturn in conjunction with the Moon (Saturn 1° 58′ S.).

A REMARKABLE METEOR.—Mr. W. F. Denning writes:—"On February 19, at 9h. 24m., a brilliant meteor was seen by Mr. and Mrs. Wilson from Reigate, Surrey, and by Mr. Peecock from Stowmarket. The object was a very exceptional one for its slowness of flight. At Stowmarket the meteor is described as having a bright reddish-yellow head, with a glowing tail about 15 degrees long streaming behind. It was traced from low in the south-west to low in the north-east. It was in full view for thirty seconds or more.

"At Reigate only the last 27 degrees were observed from just north of Coma Berenices to close to Arcturus. It was the slowest meteor ever witnessed by the observers, who counted sixty, equal to about thirty seconds, while it descended. It showed a bright head, and a yellow tail marked its path.

"The object probably had its radiant south of Orion, and its course lay from about the English Channel, south of Devon, to the coast of Holland. The whole of the path traversed must have been about 520 miles, but the heights cannot be exactly determined from the materials. Another good description of the apparent flight would be very valuable. The night was clear, and many persons in the south-eastern counties must have had a fine view of the phenomenon."

THE PHOTOGRAPHIC SPECTRUM OF NOVA LACERTÆ.—In No. 4473 of the *Astronomische Nachrichten* Dr. Max Wolf reproduces and describes the photograph of the spectrum of Nova Lacertæ which he took with the Zeiss two-prism spectrograph (exposure 90m.) on January 13. At first glance the spectrum consists of seven broad bright bands, of which six are accounted for by the hydrogen lines $H\beta$–$H\eta$; the seventh has a wave-length of about 463 $\mu\mu$. The nova spectrum declines abruptly in intensity at about λ 360, not extending nearly so far into the ultra-violet as do the spectra of the Orion stars. The order of brightness of the broad bands is $H\gamma$, $H\delta$, 463, $H\epsilon$, $H\beta$, $H\zeta$, $H\eta$. Dr. Wolf gives the wave-length measures of the different parts of each band, and also finds other faint bands having their centres at the wave-lengths 451·3, 447·4, 443·4, and 405·8; three other broad, faint bands have their maxima at $\lambda\lambda$ 427·3, 425·6, and 422·9.

RECENT OBSERVATION OF HALLEY'S COMET.—To *The Observatory* (No. 432) Prof. Barnard sends the following observation of Halley's comet on January 8, at 21h. 30m. 56s. G.M.T.:—R.A. = 11h. 47m. 16·65s., apparent dec. 18° 24′ 44·3″ S. The comet was 32·8″ diameter, round, and slightly condensed, but had no nucleus. With the 40-inch refractor, its magnitude was estimated to be 13 or 14. Prof. Barnard hopes to be able to follow the comet for the greater part of the present year, and this will provide an enormous arc, over which the comet has been observed during the present return; the determination of its path during this revolution will thus be considerably simplified. In April next the comet will be as far from the sun as is Jupiter.

SEARCH-EPHEMERIDES FOR WESTPHAL'S COMET (1852 IV.).—In No. 4475 of the *Astronomische Nachrichten* Herr A. Hnatek publishes three search-ephemerides for Westphal's comet, which may be found during the coming spring or summer. The three ephemerides are based on the assumptions that the period of the comet may be sixty, sixty-one, or sixty-two years respectively, and each covers the period April 10 to September 7. The rediscovery is doubtful, however, for the calculated magnitudes lie between 10·3 (August 28, 1911) and 13·4.

OBSERVATIONS OF THE ZODIACAL LIGHT AND THE GEGENSCHEIN.—Herr Banachiewicz describes a brilliant apparition of the zodiacal light, seen at Kasan on January 26–27, in No. 4474 of the *Astronomische Nachrichten*. The light extended to Saturn, and the middle of its pyramidal form passed over the stars δ, ϵ, and ζ Piscium. As compared with the Milky Way, the light appeared of a slightly reddish hue, and, so far as the two phenomena can be compared for brightness, was about equally bright.

Observations of the counterglow, or gegenschein, were made by Mr. Innes, Mr. and Mrs. Wood, and Mr. Worssell at the Transvaal Observatory during September and October, 1910, and are published, with sketches, in No. 5 of the Circular. Mr. Innes reports that on September 24, 25, and 26 the counterglow was, and had been, remarkably distinct, lying along the ecliptic as a lens-shaped mass about 10° broad and about 90° long; in spite of the sky-illumination from electric lights and veld fires, visitors were able to see the phenomenon immediately their attention was directed to it. Mr. Worssell gives its approximate limits on October 4 at 9h. 40m. (G.M.T.) as N. +17·5°, S. −4·5°, preceding, 0h. 5m. and following 1h. 20m., thus making the position of the centre R.A. 0h. 32m., dec. $+5\frac{1}{2}$°.

THE MURNPEOWIE METEORITE.—The annual report of the South Australian School of Mines for 1909 contains a very interesting description of the iron meteorite discovered in August of that year. The discovery was made by some boundary-fence repairers working near Murnpeowie, Lat. S. 29° 35′ L. and Long. 139° 54′. Mr. L. Laybourne Smith, the curator of the museum, says the country at this place is flat and devoid of stones. The object is a siderite weighing 2520lb., its greatest height 35 inches. The chemical composition has not been determined. Mr. Smith is making inquiries with a view to finding the date of the fall. "Australian bushmen are very observant, and this isolated 'rock' would not have been overlooked in a position less than half a mile from where the fencers were working. The holes also would fill with sand in a few years. It is probable, therefore, that the Murnpeowie meteorite is a recent arrival."

INTERNATIONAL HYGIENE EXHIBITION, DRESDEN, 1911.

FOR some months past very conflicting statements as to the attitude of the Government towards the International Hygiene Exhibition to be held in Dresden have been made, but we are now assured that the President of the Board of Trade has given it his blessing, and that some of those who have hitherto held aloof, owing to some misunderstanding, have expressed their approval of the movement. It is to be hoped, therefore, that Great Britain will be properly represented in what promises to be one of the most important scientific exhibitions and congresses of modern times. This exhibition is not merely for the advertising of trade products, nor is it intended that it should compete in any way with such trade exhibitions as, for example, that to be held at Turin. Rather is it to be a collection of apparatus and appliances, so arranged and classified that experts or others interested in matters pertaining to hygiene may study, compare, and contrast the most modern and best hygienic contrivances.

Our German cousins, with their genius for organisation and attention to detail, have spared neither trouble nor expense in laying solid foundations, and it now rests with other countries to assist in the building of an adequate superstructure. Great Britain can ill afford to be behind in a race in which, hitherto, her lead has been preeminent; and although she must do voluntarily, through individuals and private organisations, what by other countries is done by the State, it is to be hoped that now all misunderstanding has been cleared away a united effort will be made, not only to raise the rest of the necessary funds, but to send sufficiently imposing exhibits.

Some idea of the thoroughness of the work that is being done may be gathered from the fact that a "News Bureau," from which is issued what may be called a small newspaper—*Hygieia*, has been formed in connection with the exhibition. Of this leaflet, Nos. 16, 18, and 19, all of them published in January of this year, may here be referred to. The first deals with the department of "statistics," and not only affords an indication as to the objects of the promoters of the exhibition, but serves as a guide to would-be exhibitors as to what is most likely to be of use and interest to the "public" whom this exhibition is expected to attract. We are told that the collection of statistics brought together by the German Government has cost something like 350,000*l.*, that games and their influence on health will be illustrated, and that the various implements employed in carrying on these games will be fully set forth. The hygiene of civilised life will naturally receive most attention, but the method of life of savage tribes will also be demonstrated—dwellings, food, mode of life, and the like, of bushmen, Australian aborigines, primitive Indians, North American Indians, all being illustrated. One of the leaflets is devoted almost entirely to milk, under such headings as hygiene of milk; exhibits of apparatus and methods for the bacteriological investigation of milk; models, drawings, and photographs to show the dangers arising from dirty milk; the proper treatment of milk practicable even in small dairies; methods of sterilisation and milk inspection; and the hygiene of butter and cheese. Hygienic cowhouses and fittings, and the best methods of keeping cattle in dairies, and so on.

Another leaflet, No. 19, deals with subjects very different in character—the action of light and special forms of light, such as the ultra-violet rays, the action of radium, and radio-active substances; and then darts off suddenly into an entirely new region, where exhibits and statistics con-

cerning sick clubs, insurance against illness, and many of those other schemes promoted by the German Government, the importance of which is now being so fully realised in other parts of the world, are to be on view.

It is to be hoped that now the matter has been taken up, those interested in British sanitary science and the scientific aspects of hygiene generally, will spare no effort to make the British exhibit, in part at least, worthy of those great leaders of sanitary science who, shortly after the middle of the last century, did so much, not only for Great Britain, but also for other civilised countries.

THE RUSTING OF IRON.

THE problem of the atmospheric corrosion of metals is a very old one. So long ago as 1769, only three years after Cavendish had demonstrated the solubility of chalk and magnesia in water charged with "fixed air" or carbonic anhydride, it was shown by T. Lane, an apothecary of the City of London, that "water impregnated with fixed air will dissolve a considerable quantity of iron, and thereby become a strong chalybeate" (Priestley, "Experiments on Air," 1772). Lane records (Phil. Trans., 1869, l., 218) that "the clear water . . . decanted from the filings and ochrous sediment . . ., being exposed to the open air, presently threw up a party-coloured pellicle, and deposited a yellowish sediment."

In this way the foundations were laid for the theory of rusting put forward in 1888 by Crum Brown, according to which the action consists essentially in the dissolution of iron by carbonic acid, and subsequent precipitation from the solution of ferrous bicarbonate of ferric hydroxide formed by the interaction of the ferrous salt with atmospheric oxygen; the separation of the rust is accompanied by the liberation of the carbonic acid, which is thus set free to attack a further quantity of iron.

The correctness of Crum Brown's theory was confirmed by Moody's observation (Trans. Chem. Soc., 1906, lxxxix., 720) that iron which had been cleaned with chromic acid could be kept for long periods in contact with water and air in a glass tube from which all traces of carbonic acid were carefully excluded. Friend (Proc. Chem. Soc., 1910, xxvi., 179) has confirmed this observation by condensing water distilled from an alkali upon an iron tube cooled by circulating water.

In a paper which has recently appeared in the Journal of the Chemical Society, Messrs. Lambert and Thomson have arrived at conclusions differing somewhat from those of Moody and Friend. By electrolysing ferric chloride between electrodes of pure iridium foil, a specimen of iron was obtained which gave a crystalline nitrate entirely free from the violet colour which usually characterises this salt and ordinary ferric alum; the nitrate was transferred to an iridium boat, ignited, and reduced in a stream of hydrogen in a silica tube at 1000°. The metal thus obtained (which appears to have been so pure as to be acid-proof, like the redistilled zinc prepared some years ago in Sir William Ramsay's laboratory) was found to be unacted on by purified oxygen and purified water, but when platinum vessels were used in preparing the iron, the metal was found to be oxidised in the course of two or three hours, and a similar result was observed in the case of commercial iron, whether it was cleaned with chromic acid or not.

The different results thus obtained may very possibly be attributed to a difference in the vessels in which the iron was exposed to the action of water and oxygen. The dominant factor in promoting the atmospheric corrosion of iron is undoubtedly carbonic acid, but there is no reason to suppose that the part of the carbonic acid might not be played by any other acid strong enough to act upon the iron, though weak enough to be liberated by oxidation from the ferrous to the ferric state. Silicic acid, the immediate homologue of carbonic acid in the periodic classification of the elements, might very possibly be capable of producing a like effect, and, if so, the use of silica tubes would be likely to promote rusting to a far larger extent than tubes made of glass. The use of silica tubes by Messrs. Lambert and Thomson in an experiment in which one of the main objects was to eliminate acid impurities is a change of which the advantages are very questionable. The soluble (alkaline) matter dissolved out from ordinary glass does not suffice under normal conditions to prevent rusting from taking place in glass vessels, but it is noteworthy that under the conditions of Moody's experiments contact with the actual (acid?) surface of the glass was sufficient to cause the metal to rust, whilst Friend has recorded a similar effect produced by particles of slag embedded in the iron. T. M. L.

ECONOMIC GEOLOGY IN THE UNITED STATES.[1]

THE three bulletins referred to below have been issued by the United States Geological Survey, which, at all times keenly alive to the importance of economic geology to the nation, has of late years been paying particular attention to the study of the mineral resources of the United States. The two first bulletins give an elaborate and detailed account of the geology of one of the most important oil-producing regions of central California. Very little accurate geological work had been done here previously, so that the present bulletins form a useful contribution to general stratigraphical geology as well as to the special geology of oil-bearing regions. There is nothing that calls for particular notice in these bulletins; the oil appears to occur in strata of the customary type of Eocene, Lower and Middle Miocene age. Both reports are elaborate and full of detail, and the report on the Coolinga district is noteworthy for the amount of palæontological information that it contains and for the admirable manner in which some of the fossils referred to have been illustrated in the accompanying plates.

The third of these bulletins deals with an entirely different subject, namely, the methods recently introduced by the United States Government for the purpose of placing its system of purchasing its coal supplies upon a scientific basis. The method is roughly as follows:—For each coal the moisture, ash, and calorific value (expressed in British thermal units) are determined upon samples taken with all due precautions. The bids of the various samples are sent in on official sealed forms. In order to compare these, all the tenders are reduced to the same ash value by selecting as standard the coal containing the lowest percentage of ash; for each 1 per cent. of ash above this figure, 2 cents per ton is added to the tender price. From this price thus adjusted, and from the calorific power as determined, the cost per 1,000,000 B.T.U. is calculated for each coal offered, and as a general rule the contract is awarded to the lowest cost as thus ascertained. As the heat value of the coal is determined upon the coal as received, there is no necessity to determine the percentage of moisture that it contains. When a tender has been awarded to a contractor, he is expected to maintain the quality of the coal delivered at approximately the same standard as that upon which the contract was awarded. For this purpose careful samples are taken from each delivery; when the samples have been drawn, payment of 90 per cent. of the amount of the account is made forthwith, the balance being kept in hand until the samples are reported upon. The price is corrected for variation in calorific power, by multiplying by the number of B.T.U. in the sample and dividing by the number of B.T.U. upon which the contract was based. Similarly for each 1 per cent. less of ash in the sample of the coal delivered, a premium of 2 cents per ton is paid, and for each 1 per cent. of ash more a deduction is made in accordance with a published schedule, an increase up to 2 per cent. of ash not being, however, penalised. Of course the contract note contains clauses under which a delivery containing an excessive amount of ash, dust, or sulphur may be entirely rejected.

It will be seen that this system of coal purchasing is novel, and interesting to a wider public than that directly concerned with the supply of coal to the various departments of the United States Government. H. L.

[1] Department of the Interior. United States Geological Survey Bulletins. (Washington, 1910.)

(1) Geology and Oil Resources of the Coolinga District, California. By Ralph Arnold and Robert Anderson. Pp. 354.

(2) Preliminary Report on the McKittrick-Sunset Oil Region, Peru, and San Luis Obispo Counties, California. By Ralph Arnold and Harry R. Johnson. Pp. 225.

(3) The Purchase of Coal by the Government under Specifications; with Analyses of Coal delivered for the Fiscal Year 1908–9. By George S. Pope. Pp. 80.

THE AFFINITIES OF SCHIZOTRYPANUM.

IN a recent number of the *Archiv für Protistenkunde* (vol. xx., p. 361), Dr. M. Hartmann makes an important addition to our knowledge of *Schizotrypanum cruzi*, the trypanosome of human beings discovered by Chagas in Brazil (see NATURE, August 4, 1910). Chagas described a process of multiple fission ("schizogony"), taking place in the lung capillaries, of forms not enclosed in cells (NATURE, *l.c.*, p. 143, Fig. 2, *b–e*). In addition to this type of multiplication, Hartmann finds another process of schizogony within hypertrophied endothelial cells of the lung, as a result of which the cell contains some twenty or more small, pear-shaped organisms, each with a distinct kinetonucleus and trophonucleus, but no flagellum. The chief interest of this discovery lies in the very great resemblance of these intracellular forms of Schizotrypanum to those of *Leishmania donovani*, the parasite of Kala Azar; in fact, anyone, looking at the figure given by Hartmann, might suppose that it represented a preparation of Leishmania. Similar forms are stated to have been found in the heart-musculature and brain of human beings that have died from "Schizotrypanosomiasis" (*sic*), *sit venia verbo!*

In view of the resemblance, in certain phases, between Schizotrypanum and Leishmania made known by Hartmann, attention may be directed to some remarks by Donovan, one of the discoverers of the parasite of Kala Azar, in the "Annual Report and Statistics of the Government General Hospital, Madras," for the year 1908 (published 1909), p. 31. Donovan casts doubt on the view advanced originally by Rogers, and further supported by Patton, that the parasite of Kala Azar is transmitted by the bed-bug; and gives reasons for believing that another bug, *Conorhinus rubrofasciatus*, is the insect which propagates the disease. It would be remarkable if both Leishmania and Schizotrypanum proved to be transmitted by species of the genus Conorhinus, the one in India, the other in Brazil. The etiology of Kala Azar is a problem which calls urgently for investigation.

E. A. M.

THE ORGANISATION OF TECHNICAL EDUCATION AND RESEARCH.[1]

VERY few words of mine are needed to emphasise the interest and the importance of this annually recurring ceremonial at which the varied educational work of the City and Guilds Institute receives recognition, well-merited recognition, from successive Lord Mayors.

We gather from the brief *résumé* of the work which has been read by Sir J. Watney that the various agencies combined under the control of the institute continue to flourish, the students increase in number, their work rises in quality, and the importance of the institution grows greater year by year.

The City and Guilds Central Technical College completed its twenty-fifth session in July, and now has at work 412 students. In the twenty-five years, 1512 students have taken the complete course and 1066 have been awarded the diploma. Out of 306 internal degrees conferred in the faculty of engineering in London University, 157 have been obtained by students of the college; and the percentage in honours has been a high one, 56 per cent. first class, 42 per cent. pass.

The year has been marked in that the relations with the Imperial Technical College have been made definite by the appointment of a delegacy, under the immediate control of which the City and Guilds College is placed, and which contains representatives of the Imperial College, the Institute, and the Goldsmiths' Company. The delegacy, I am informed, held their first meeting last month.

I will not attempt to review in like manner the year's results for the other branches of the institute. Numbers of young men—some of them not so young now—owe their success in life to the training received at the Finsbury Technical College from the inspiring teaching of its accomplished head, Prof. S. P. Thompson, and his able staff; and here I should like to thank Prof. Thompson for his recent brilliant addition to our scientific biographies. Had he done nothing else, and this is far from being the case, his life of Kelvin would have left future generations deep in his debt.

I know less, perhaps, of the other work of the institute, but I know enough to be grateful to the committee and its officers for the large contribution to the advance of knowledge they have made by their efforts in the past.

The choice of a subject for an address of this kind is not quite easy, and yet it ought not to be very difficult for a man whose life is now bound up with the business of science to find a theme on which to speak to an audience in this centre of industry and commerce—the connection of science and industry is an obvious, perhaps even a hackneyed, one. Nevertheless, I am going to trespass on your patience with some aspects of the question as they appear to me.

Not many years ago it would have been said that the connection was a slight one. Science dwelt in a realm apart from industry and commerce; her votaries were men who sought the truth without a thought of the gain the search might bring to humanity, or the wealth it might discover for the seeker.

It was enough for them to arrive at some new law, to roll back a little space the veil that shrouds the mysteries of Nature and to penetrate her shrine. Long may there be such men; the humbler students of science, those who try to interpret her teachings for the good of men, could advance but little without the torch of truth carried by these their leaders. But it is realised now that there are many ways in which science can further industry. Let us look at two of these.

It is sometimes said our German cousins are more scientific than ourselves, and that this is the reason of their great material progress during the past fifty years. In a sense this is true; not that they have made greater discoveries or have contributed more to the sum of human knowledge, but they did realise at an earlier date than we the value of science as a factor in industrial and commercial progress. They showed their appreciation of its importance by the establishment, in the first place, of technical colleges and universities where students could be trained to apply science to the needs of daily life, and in the second of institutions like the Reichsanstalt and the Versuchsanstalt, where researches on matters bearing on the application of science to industry could be carried out on a fitting scale.

The colleges and universities which in the past twenty-five years have grown up in our cities show that we have begun to appreciate the need and to make some notable endeavours to supply it. For the success of these endeavours, no small debt is due to those great City Guilds which, with well-judged munificence, have devoted such large funds to the work of education, not only here in London, but also in the ancient universities and in many other parts of the country.

This gathering to-night, with its long list of prizes and awards, is a speaking testimony to the value of their work in London. The wise leaders of the City Guilds realised that by the work of education they could best advance the welfare of our country and carry on under present conditions the task which previously they performed by means of the apprenticeship system.

Let us look into this educational work in its modern form. It received a notable impulse a few years ago by the establishment of the Imperial College of Science and Technology. That college was founded with a very definite purpose—to afford to English students the opportunity for the highest study and research in any branch of science bearing on industry. Two methods at least were open to the founders, and of these they chose the more difficult. It is our English plan to let our old institutions develop gradually, so as to meet new needs. The committee responsible for founding the Imperial College might have established something quite new; they decided rather to combine three great agencies existing at South Kensington into one, thus coordinating work already in progress, while maintaining the individuality of the constituent institutions. The Royal College of Science, the Royal School of Mines, and the City and Guilds Technical College still exist, but, combined as they are under one governing body of the Imperial College, their

[1] Address delivered at the prize distribution of the City and Guilds of London Institute on February 17, by Dr. R. T. Glazebrook, F.R.S.

influence on education and on progress, great as it has been in the past, must be multiplied manifold.

Time is necessary to solve the many problems that arise, but a visit to South Kensington, where, by the generosity of Messrs. Wernher, Beit and Co., and the trustees of the Bessemer fund, splendid new buildings are rising rapidly for the Royal School of Mines, and by the munificence of the Goldsmiths' Company the engineering laboratories of the central institution are being so greatly enlarged, is enough to show some of the first-fruits of the work.

The method which has been adopted for controlling the work of the Central College by means of a delegacy representing the Imperial College, the City and Guilds Institute, and the Goldsmiths' Company, is full of promise, and the path whereby the whole can develop into the great institution planned by its founders seems clear.

Much is still necessary before that development can be complete. In the first place, we must encourage research. The Central Technical College has a splendid record among its professors—Henrici, Unwin, Ayrton, Armstrong. Nor will the work of the younger men—Dalby and Mather—be less distinguished in the future. Still, more remains to be done in the way of post-graduate study and students' research. I do not overlook the notable efforts made lately in connection with the railway engineering course, but I would urge those in whose hands control lies so to organise the teaching that men, professors, or students who have the power to carry on research, should be free to use it. You cannot successfully command a professor to make discoveries. You can arrange his surroundings so that the power that is in him should have full opportunities of action.

Secondly, we must not attempt in the Imperial College to do elementary work which can be done equally well elsewhere. The Central Technical College has always done rightly in selecting its students with care. Its success, and the fact that the students now number as many as the college can hold, increase its power of selection; the conditions of entrance may be raised gradually; they are still very low compared with the great German technical schools; and thus the whole character of the work may be improved.

Thirdly, the Imperial College must not remain isolated. The agencies at work in London applying science to the wants of industry, not merely teaching the rudiments, but advancing the boundaries between the known and unknown, are numerous; they include the University Colleges, with their distinguished professors and their large classes of students; the polytechnics and technical schools, where, day and night, educational work of the highest value is being eagerly pursued.

Is it impossible to conceive some scheme by which the labours of all these agencies for technical instruction should be coordinated and linked up with the work of the Imperial College as a centre, to which, to repeat what I said in an address I delivered to the Association of Technical Institutions, students only of proved capacity were admitted, where the staff and students were free to conduct original investigations, and through these to learn new truths, where scholars and prizemen from the various technical institutions of London were collected, and where the teachers in the polytechnics and other colleges were freely welcomed to carry out their researches and to advance learning?

In close connection with this there should be a number of colleges organised so as to provide teaching for the less advanced stages of the course, selected with due regard to geographical conditions.

Beyond these would come those polytechnics which were engaged chiefly in evening classes for the worker, each, if possible, with one special department organised so as to provide teaching and means for research of an advanced character, linked up to the central institution, the Imperial College, in such a way that the teachers felt a common interest in promoting the welfare of that institution, and turned naturally to its professors as their leaders in the search for truth.

There is one essential more. This group of institutions —the Imperial Technical College and its associated colleges—must possess the power itself of granting degrees in technological science to its students who have gone through its course and passed the proper tests without reference to any external academic body. To secure this may be difficult, but it must be done. In Germany it was recognised some years ago that the degree courses of the older universities did not afford the student of technology the training he required, and new universities —technological universities they are called, though the phrase may be a misnomer—have been established in many of the great centres of industry.

Here in England, outside London and the old universities, our course has been different. The new universities in Manchester, Liverpool, Birmingham, and elsewhere, have each a faculty of technology along with those of arts and science, law and medicine, and their constitution allows them to do this with success, for in no case is the control in the hands of an academic body—an unwieldy Senate representative of all and every conflicting interest that can conceivably be brought in. It rests with a compact council, consisting mainly of business men, keen to raise the standard of education in their cities because they realise that on that progress turns.

It may be possible to reorganise London University as an assemblage of faculties, each practically independent in its own sphere, each controlled by its council, a small body of men containing some few representatives of the teaching staff. This council, within the scheme, would be the supreme body of the faculty; subordinate to it would be the general board of studies, representing all the teachers, and the special boards dealing with the various subjects of study in the faculty. Each faculty should award its own degrees and be free to determine, with the lines of the general scheme, the conditions under which those degrees should be granted.

There would need to be advisory committees of representatives of several faculties for work in which more than one faculty was concerned, and a small body, independent of the faculties, to settle disputes which might arise.

Under such a scheme the Imperial College would become the centre of the Technological University for London, and then for the Empire, a body like its governing body, but modified so as to include representatives of the other institutions which would form with it the technological side of the University in London, would become the council of that faculty; the teachers in the various subjects represented in the faculty would form the various special boards of studies, and representatives of these special boards would become the general board of studies of the faculty.

Whether this be a possible scheme or not it is not for me to say, but I would venture to put forward three propositions:—

(1) That a combination of the technological departments of existing institutions and schools into an independent technological faculty is necessary.

(2) That in such a faculty a definite value should be given to technical education in each London school.

(3) That the technological faculty should confer degrees under conditions to be laid down by the faculty.

I am aware I have wandered into debatable ground. I trust I have not erred beyond forgiveness in so doing. The task before Sir Alfred Keogh, the rector of the Imperial College, in bringing to success some scheme such as this is no easy one. It will lighten it immensely if you can assure him that in his task he has your own support and that of the men to whose active help the success of the City and Guilds Institute is so largely due.

You may rest assured that in this way you are assisting in no small degree to render the advances of science available for the promotion of the best interests of our nation, in strengthening our position in the world, and in carrying on that great work of education in which the City Guilds have taken so admirable a share.

But there is another aspect of my subject, the relation of science to industry, for which I have left too little time. A second way in which science may help industry is, as I have said, by the establishment of institutions where scientific questions bearing on industry may be studied.

The National Physical Laboratory is such a place, and when the chairman of the committee invited me to speak

here to-night, he said he wished me to tell you something of the work of the laboratory.

It is a big work, for the subject is big. The laboratory was founded some ten years since as a public institution for standardising and verifying instruments, for testing materials, and for the determination of physical constants.

Its staff now numbers about 140 persons, its expenditure during the past year was more than 28,000*l.*, and towards defraying that expenditure more than 15,000*l.* was received in fees for work done.

During the past eleven years, if we exclude the aëronautical work, 49,000*l.* has been contributed from public funds towards capital expenditure, while 54,000*l.* has been raised from private sources. In the same period, the annual grants from the Treasury for working expenses have been 57,750*l.*, while the receipts from fees, private donations, and subscriptions have come to 105,380*l.*

Instruments of all kinds were examined, among them in 1910 were 27,500 thermometers, 4000 telescopes, 1600 binoculars, electrical apparatus, measuring apparatus, optical appliances, photographic lenses, opticians' testing lenses (these numbered 5000), and taximeters. The value of the instruments sent for test is nearly 1000*l.* for each working day of the year.

Nor is this half of the work. Researches of all kinds of interest to industry and manufactures are in progress. Papers have been communicated to engineering and scientific societies which have aided in the solution of many important technical problems, and investigations are now in progress which will help still further.

The laboratory is controlled by a committee appointed by the Royal Society and representing the great scientific and technical societies, and the general scheme of research is approved by them. But besides these public investigations, each day brings us inquiries from private firms and manufacturers as to matters on which they want our help or our advice.

The home of the laboratory is at Teddington, in Bushy Park, and there, round the old Royal residence, Bushy House, the modern buildings needed for the work are being slowly and painfully raised. For some of these funds have been provided by the Government; others we owe to private generosity to men like Sir Andrew Noble, Sir John Brunner, Mr. Yarrow, who has just built for us an experimental tank for naval research at a cost of 20,000*l.*, Sir Julius Wernher, whose generous gift of 10,000*l.* has rendered it possible to commence the erection of a laboratory for metallurgical research, or to those of the city companies, the Goldsmiths', the Drapers', and others, who have listened to our appeal.

Meanwhile, we live from hand to mouth; the deficit this last year, on a total expenditure of nearly 30,000*l.*, was about 200*l.*, and now we are appealing for funds to build an optical laboratory, a library, and reading room, with other offices for our work.

We shall not appeal, I know, in vain, because Englishmen at last are realising that organised scientific effort is an essential factor in the country's progress; you students who in the various colleges of this institute have learnt something of what science is, what scientific effort can do, in time some of you will become the leaders of industry. See to it, then, that those institutions to the work of which your success is due are made ever more efficient through your generous support.

PROGRESS REPORT OF THE CARNEGIE INSTITUTION OF WASHINGTON.

THE ninth annual report of the Carnegie Institution of Washington, in which the numerous activities of the institution during 1910 are described, is now available. The volume runs to 275 pages, and contains also five well-reproduced plates. As usual, the report includes the articles of incorporation of the institution, its bye-laws, the minutes of the meeting of the Board of Trustees, the report of the president of the institution, that of the executive committee, as well as detailed reports on the numerous investigations and projects of the institution.

The president's report presents in order a review of the work of administration of the institution, a *résumé* of the investigations carried out during the year, and a summary of the publications authorised and issued during the year ending October 31, 1910. The subjoined extracts from the report will serve to illustrate the increasing importance of the research work undertaken under the auspices of the institution.

Work of Administration.

The more noteworthy events in the history of the institution during the past year are the dedication, in December, 1909, of the Administration Building; the inauguration at that time of an annual series of semi-popular lectures explanatory of the researches of the institution; the inauguration on the same occasion of a series of periodical exhibits of the work accomplished by the departments of investigation and the divisions of publication and administration; the successful completion of the first voyage (of 8000 miles) of the non-magnetic ship *Carnegie*, and the beginning of a second cruise, which is expected to require three years, by this novel craft; and the fourth conference of the International Solar Union, held at the Solar Observatory of the institution on Mount Wilson, California, from August 29 to September 4, 1910.

It appears that since its organisation in 1902 upwards of twelve hundred individuals have contributed in one way or another to the promotion of the researches and the publications undertaken by the institution. During each of the past five years about five hundred individuals have thus collaborated. Ten independent departments of research and the divisions of publication and administration, each with its staff and assistants, have been organised and established within the institution itself. In addition to these larger departments of work, numerous special researches, in aid of which upwards of seven hundred grants have been made, have been carried on by research associates and other individual investigators. For the departments of research, two astronomical observatories, five laboratories, and a non-magnetic ship have been built and equipped.

The following list shows the departments of investigation to which the larger grants were made by the trustees, and the amounts allotted from those grants by the executive committee during the year:—

	£
Department of Botanical Research ...	6,946
Department of Experimental Evolution ...	8,194
Department of Economics and Sociology...	2,000
Geophysical Laboratory	10,204
Department of Historical Research ...	4,540
Department of Marine Biology	5,414
Department of Meridian Astrometry ...	7,131
Nutrition Laboratory	5,276
Division of Publications	1,800
Solar Observatory	23,144
Department of Terrestrial Magnetism ...	15,384
	90,032

Résumé of Investigations of the Year.

Work in the ten specially organised departments of research in the institution has gone forward during the year with increasing vigour and with increasing productivity. But while the existing status of departmental affairs is in general highly satisfactory, it appears essential again to direct attention to the fact that with present income and current economic conditions no further expansion of departmental appropriations can be expected. It may be necessary, on the contrary, to curtail research in the departments in order to keep the aggregate expense of the institution within income. It need not follow, however, that this prospective diminution in financial outlay will cause a corresponding diminution of productivity, for work of investigation, like work along other novel lines, is usually most costly in the preliminary stages.

The headquarters of the Department of Botanical Research are located in a desert area where the facts of plant life are exhibited, in general, in their simplest, though often extreme and highly specialised, relations. During the year the director of the department has continued his investigations on the water-balance of succulent plants, on the conditions of vegetable parasitism, on the variability in plant species induced by chemical treatment of their seeds, and on the influences of climate on plant organisms.

In collaboration with Prof. Ellsworth Huntington, the director has begun a general climatological study of the region about Tucson, giving special attention to the factors and effects of the Santa Cruz and Asuncion river systems. Dr. Cannon has given attention especially to his elaborate investigation of the root systems and habits of desert plants. For the purpose of extending the range of his studies in this fundamental subject, he visited the Sahara Desert, and will spend most of the year in that advantageous field for both comparative and direct observations. Dr. Shreve, while occupied with the more general problem of the relation of plants to climate in the United States, has also carried on special investigations of the vital statistics of plants in the vicinity of the desert laboratory, of the vegetation in the Santa Catalina Mountains, and of the physiological characteristics of the lace-fern family of plants. Observations on the phenomena presented in the drying up of Salton Sea, and especially on the influx of vegetation over the bared strands and islands of this slowly retreating body of water, have been continued during the year.

So many converging lines of fruitful research are now being pursued by the Department of Experimental Evolution that it is difficult to summarise fitly its current progress. From the abstract scientific point of view, the most interesting feature of this work is found in the introduction of statistical and other quantitative methods, whereby biology is now passing from the first to the next higher stage in the development of a science. From the more popular points of view, the work in question is of special interest by reason of its bearing on the economics of plant and animal breeding, and by reason of the light it is certain to shed on the laws of human heredity.

The principal steps which have been necessary, and in large degree preliminary in the development of the work of the Geophysical Laboratory, are four in number, namely, provision for correct temperature determinations over the entire range involved in the processes of rock formation; provision for like determinations of the chemical reactions of these processes; provision for precise microscopic, optical, and crystallographic measurements; and provision for the quantitative applications of high pressures to rock masses and rock constituents. In supplying the desiderata just indicated for its own special work, the laboratory has already achieved results of prime importance also to many other fields of physical and chemical science. Thus, two contributions of great import to general physics and chemistry have been brought out during the past year. The first of these is a determinate extension of the scale of temperature measures from about 300° C. to about 1600° C. This is a fitting supplement to the classic work on thermometry begun more than thirty years ago under the auspices of the International Bureau of Weights and Measures. It must take rank, in fact, with the fundamental advances in the technique of thermometry. The other contribution is a determination of the system of compounds which may arise in combinations of the three most important oxides entering into the composition of rocks, namely, silica, lime, and alumina. This system is of special economic interest, since it includes, among many other compounds, the hitherto much studied but baffling Portland cement. The complexity of the investigations required to analyse this system is indicated by the facts that it involves the interaction of fourteen minerals and the formation of sixteen ternary eutectics, or substances the melting points of which are lower than those of the primary constituents.

Two emergencies seriously affecting the Department of Marine Biology, and calling for prompt action, have arisen during the year. One is due partly to the gradual abandonment by the U.S. Navy of the supply depôt and wireless station at Tortugas, where the department's laboratory is situated, thus rendering communication between Key West and the laboratory less certain and frequent than hitherto. The curtailment of this source of aid generously extended by the Navy to the laboratory during the past six years has forced upon the department the necessity of providing better independent transportation than that afforded by its best boat, the *Physalia*. Accordingly, plans and specifications for a 70-foot twin-screw boat were prepared during the summer, and on authorisation by the executive committee, a contract for the construction of this proposed vessel was let, with the expectation that the contract will be completed in July next. The other emergency arises from the damage to the laboratory caused by the hurricane of October 14–18, 1910. The extent of this damage is not definitely known at present, but steps have been taken to get trustworthy details at the earliest practicable date, so that estimates of the expense required to restore the building may be ready for submission to the Board of Trustees before their next meeting. It is gratifying to note that the opportunities afforded for intensive research by the laboratory are so highly appreciated that applications for its privileges are already more numerous than can be granted.

Capital progress has been made during the year in the large and exacting undertaking which the Department of Meridian Astrometry has so successfully started. Work at the observatory in Argentina has gone forward at an unprecedented rate, and with such a degree of thoroughness and completeness as to give assurances that this part of the enterprise will be completed within the next year. While the supplementary observations of the positions of the stars are going forward in the southern hemisphere, arrangements for the final computations of these positions are proceeding at the Dudley Observatory; for the formidable task of observation must be followed by a still more formidable task of computation. Preliminary to the grand catalogue of stellar positions projected by the department, there has been issued by the institution during the past year, as Publication No. 115, a catalogue of 6188 stars for the epoch 1900.

Although the Nutrition Laboratory has been occupied less than two years, and is not yet fully equipped, it has already produced contributions of fundamental importance to our knowledge of the chemistry, physics, physiology, and pathology of nutrition. Its experience, like that of all the laboratories of the institution, affords an impressive demonstration of the productivity attainable by concentrated effort along determinate lines of research. Construction and installation of additional equipment, the prosecution of investigations, and the publication of results have gone forward simultaneously during the year. One new calorimeter has been completed, another partly constructed, and various auxiliary apparatus for use with these and the earlier equipments have been supplied. Similarly, respiration apparatus for men, respiration apparatus for dogs, and many improvements in the calorimeter section of the laboratory have been made. Several pieces of apparatus have been acquired also by purchase abroad, and the efficiency of the machine shop has been improved by the addition of a precision lathe.

The work of the Solar Observatory is now so extensive and so varied that it is somewhat difficult to summarise even in its salient aspects. In addition to the observatory proper, with its four principal telescopes and much auxiliary equipment on Mount Wilson, there are the physical laboratory and the instrument shops at Pasadena, along with special divisions devoted to the work of computations and construction respectively. By way of equipment, several large pieces of apparatus for the new tower telescope, for the 60-inch telescope, and for the 100-inch grinding machine have been made at the shops. The towers for the new 150-foot tower telescope, begun a year ago, are now finished, along with the well, 75 feet deep in the rock below, which forms a part of the telescope tube of this novel instrument, now essentially complete except for its spectroscopic attachments, still under construction at the shops. Some preliminary trials made recently with this instrument indicate that it will fulfil the sanguine expectations entertained in respect to its capacity.

The more striking events of the year in the Department of Terrestrial Magnetism refer, naturally, to the non-magnetic ship *Carnegie*, which was off on her first cruise at the close of the previous fiscal year. She was then at Falmouth, England, where her determinations of the magnetic elements were compared with independent determination made at the permanent magnetic observatory of that port. She proceeded thence, November 9, 1909, to Funchal, Madeira, thence to Hamilton, Bermuda, and thence, under tempestuous conditions which proved her seaworthiness, to Brooklyn, N.Y., where she arrived February 17, 1910. Here she had her copper sheathing applied by the constructors, as required by their contract,

and was overhauled and refitted for a three years' circumnavigation cruise. In all essential respects this vessel has proved more effective than was anticipated. It has been demonstrated that even in rough weather the three magnetic elements may be determined with a precision little short of that attainable in a fixed observatory. Thus she was able to discover on her first cruise errors of unexpected magnitude in the best sailing charts of the north Atlantic, and she is certain to attain at least an equal degree of precision in all future ocean work. By crossings of her own tracks and by connections at all available ports having magnetic observatories, it will be practicable to exclude the possibilities of any important errors in this work. Similarly satisfactory progress has been made also in the land work of the department during the year. The expedition in Africa, from the Cape to Cairo, undertaken by Dr. Beattie and Prof. Morrison as temporary associates, was completed early in the year, a total of 348 stations having been occupied. Mr. Pearson continued work in Turkey in the early part of the year, until relieved by Mr. Sligh, who extended the work to Palestine, Syria, Arabia, Mesopotamia, and the islands of Rhodes and Cyprus. Up to the end of July of this year, these two observers had occupied a total of forty-seven stations. Another observer, Mr. Stewart, left Washington early in June to begin extensive work in South America, proceeding in the launch *El Imán*, provided especially for work along the Amazon and its tributaries. Additional observations are reported also from Canada and from various European countries in which initial determinations or instrumental comparisons have been made.

The publication of twenty-three volumes has been authorised during the year by the executive committee, at a total estimated cost of 7980*l*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Sir George H. Darwin, K.C.B., F.R.S., has been nominated to represent the University at the celebration in September of the secular jubilee of the Royal Frederic University of Christiania.

The special board for medicine report that an examination in psychological medicine and its cognate subjects, if established, could not fail to raise the present standard of efficiency in applicants for asylum posts, and that it would lead to the provision of appropriate courses for the training of those who wish to advance our knowledge of psychiatry. The board accordingly recommends that such an examination be held once in the year, and that a candidate who passes both parts of the examination to the satisfaction of the examiners be entitled to a diploma testifying to his competent knowledge of psychological medicine.

Oxford.—The report lately published of the School of Geography gives evidence of much activity. It mentions with regret the resignation of Sir Clements Markham from the committee of the school, adding that the University owes much to Sir Clements Markham for his efforts to promote the teaching of geography in Oxford during a quarter of a century. The generous gift from Sir Abe Bailey of 250*l*. a year for five years has enabled the committee to provide increased accommodation in Sir Henry Acland's house in Broad Street, thus relieving pressure on the Old Ashmolean building. More rooms are in preparation, and should be ready by Easter; meanwhile, in addition to the quarters specially assigned to the staff and students, a general reading-room has been opened, where any member of the University may consult books or maps. The committee again points out the need for an endowment for the teaching of geography in the University. Towards this, Lord Brassey and Mr. Douglas Freshfield have each offered to contribute 500*l*., provided an adequate additional sum can be obtained from other donors. Courses of lectures have been given by Prof. Herbertson, Dr. Grundy, Mr. Allorge, Mr. Beckit, and Miss MacMunn. Mr. O. G. S. Crawford, Keble College, has been appointed junior demonstrator and librarian. The geographical scholarship for 1910–11 was awarded to Mr. B. W. Baker, University College.

Prof. E. B. Tylor, F.R.S., has deposited on loan with the committee for anthropology a substantial portion of his library, to be used for the purposes of anthropological study within the University. The library will be housed, for the present, at Acland House, Broad Street.

Sheffield.—The council, at its last meeting, made the following appointments:—Dr. Sinclair White, to the professorship of surgery in the University, in succession to Mr. R. J. Pye-Smith, resigned; Mr. George Stanfield, to the post of demonstrator in engineering; and Mr. Ll. Lloyd, to the post of assistant curator of the zoological museum.

Mr. W. Buchanan, senior lecturer to Faraday House Electrical College, London, has been appointed professor of electrotechnics at the School of Mines (Transvaal University), Johannesburg.

A friend of Sir William Ramsay's, who desires to remain anonymous, has promised 2500*l*. towards the fund of 50,000*l*. required for the building of the new chemical laboratories at University College. The same donor will give a further sum of 2500*l*. provided the sum of 50,000*l*. is raised before Easter. The fund now stands at 31,277*l*.

A vacation course for the study of the structure, development, and ecology of marine algæ (Plankton and Benthos) will be conducted by Dr. O. V. Darbishire at the Dove Marine Laboratory, Cullercoats, Northumberland, during the Easter vacation. Instructions will also be given in the various methods of collecting, mounting, fixing, and cultivating marine algæ. Further information may be obtained from Dr. Darbishire, Armstrong College, Newcastle-on-Tyne.

We learn from *Science* that the U.S. General Education Board has made conditional grants as follows:—Brown University, 20,000*l*.; Carleton College, 20,000*l*.; Colorado College, 10,000*l*.; Dakota Wesleyan University, 10,000*l*.; Denison University, 15,000*l*.; Fisk University, 12,000*l*.; Mount Holyoke College, 20,000*l*.; Randolph-Macon College, 10,000*l*.; Swarthmore College, 15,000*l*.; and Wesleyan College for Women, 10,000*l*. From the same source we gather that the Bill increasing the annual appropriation from the State of Vermont to Middlebury College by 1520*l*. has been signed by the Governor. This will make the State appropriation to Middlebury 3200*l*. a year, beginning on July 1. The increase is "to provide additional instruction in the departments of pedagogy, in forestry, and in scientific branches related to the industries of Vermont." It is also stated that a gift of 10,000*l*. to Cornell University by Mrs. Florence O. R. Lang, of Montclair, N.J., will be used in the construction of a new building to house the shops of the Sibley College of Mechanical Engineering.

The University of Christiania will, in the beginning of September next, celebrate its centenary, having been founded by King Frederic IV. in 1811. Prof. K. Birkeland has kindly given us the following information relating to this celebration. Instructions have recently been sent to 226 universities or similar institutions of higher education, and to 113 learned societies, each being invited to send one delegate. It may be mentioned that the programme for the official festivities, as at present proposed, includes a reception banquet for the foreign delegates on September 4, while the actual centenary festivities will take place on Tuesday, September 5, and Wednesday, September 6. On the Tuesday, Björnstjerne Björnson's Cantate, "Lyset," will be rendered. This will be followed by the address of welcome to the foreign representatives of universities and academies, replies from groups of these representatives, and the presentation of addresses. On the Wednesday, honorary degrees and promotions will be conferred. A medal, struck in commemoration of the centenary, and various publications, will be distributed. The president of the festival committee is Prof. Brögger, rector of the University. The students have also appointed a committee, which is issuing thirty invitations for student delegates from other universities.

Mr. Jesse Collings has introduced into the House of Commons a Bill, which is influentially backed, to afford further facilities for the creation of Small Holdings. Side by side with the granting of further facilities to those who are desirous of becoming smallholders is a movement,

ıitiated by Mr. Collings, for promoting agricultural lucation and nature-study in public elementary schools. ocal education authorities may provide and maintain ıeans and facilities for the purpose of giving instruction ı any of the following subjects:—nature-study; fruit, ɔwer, and vegetable growing; poultry- and bee-keeping; ıdding, pruning, and grafting; cow- and pig-keeping; ilking; rotation of garden crops; nature and properties soils; use of manures; knowledge and choice of seeds; ructure, life, and food of plants; action of birds and sects on crops; choice and use of simple tools; packing uit, vegetables, and other produce for market. The ıportance of these legislative proposals, from a small-ɔlder's point of view, lies in the fact that they are signed to interest the children in rural districts in the cupations which ought, naturally, to constitute their ter-life. The Festival of Empire is devoting ten acres ıd some thousands of pounds to demonstrating along actical lines how the successful cultivation of small ɔldings may reclaim agricultural and rural districts. The ms and objects of the Small Holdings and Country Life ction of the Festival have the approval of the Board Agriculture and Fisheries, and experts are assisting in conduct and management under the auspices of various ricultural and cooperative organisations.

THE very representative Conference on Industrial Train-g, held at the Guildhall on Tuesday, February 28, was ɔened by a sympathetic message from his Majesty the ing. The following resolution was passed by an over-ıelming majority:—"That the national system of indus-ial, professional, and commercial training should be tablished, to which the children shall pass as a matter course (unless the parents are prepared to undertake eir future training), and without interval for a definite riod, to be thoroughly trained for entry into the par-ular calling for which they are best fitted, such training be under fully qualified instructors." The passing of is resolution marks an important change in public inion, and indicates a strong feeling that the school age ould be extended to about sixteen years of age, and that e education given during, say, the last three years of hool life should, whilst not neglecting the general educa-ɔn, be a preparation for the particular occupation the ild intends to follow. In the past it has been the prac-e to regard education as suitable only for those who tend to follow clerical occupations. The work of trade hools and of technical institutes has, however, shown at much may be done in schools and institutes under illed instructors to prepare for, and supplement, the ficient training of the workshop; but hitherto this has en done mainly in the evenings. It is now recognised at much better results would be obtained if the pupils ceived some sound practical training in the daytime at e end of their ordinary elementary-school career. deed, the changed methods of production due to the troduction of machinery, and to the consequent sub-vision of labour and decay of apprenticeship, has made me change in our system of training a necessity.

THE second volume of "Statistics of Public Education England and Wales" has now been published (Cd. 06). It deals with the financial statistics of the years 08, 1909, and 1910. The net total expenditure of the ɔard out of the Parliamentary Vote, after deducting propriations in aid, was, for 1909–10, 13,638,424*l.*, as ımpared with 13,485,233*l.* in 1908–9 and 13,272,624*l.* in 07–8. The grants to meet expenditure in respect of ementary education amounted to 11,095,420*l.*, as against ,039,281*l.* in 1908–9 and 11,023,121*l.* in 1907–8. Grants secondary schools amounted to 610,435*l.*, as against 6,107*l.* in 1908–9 and 342,393*l.* in 1907–8; for pupils in eparatory classes, pupil teachers, and bursars, 143,413*l.* in 09–10. Technical institutions, day technical classes, ıools of art, art classes, and evening and similar schools d classes absorbed 512,475*l.*, as against 493,927*l.* in the evious year; maintenance grants for training colleges, 0,985*l.*; and building grants for training colleges and stels, 60,102*l.* The Imperial College of Science and chnology in 1909–10 received 20,000*l.*, the Geological ıseum and Geological Survey 20,893*l.*, and the Com-ttee on Solar Physics 2119*l.* The only change of any importance in the present volume consists in the inclusion of tables giving particulars as to the salaries of supple-mentary, student, and pupil teachers on the staff of ordinary elementary schools. In previous years the salaries of certificated and "uncertificated" teachers alone were dealt with. It appears that in 1908–9 the average salaries of certificated teachers in Wales were: men head teachers, 146*l.* 9*s.*, men assistant teachers, 113*l.* 19*s.* 11*d.*, the corresponding amounts in the case of women being 109*l.* 16*s.* 9*d.* and 82*l.* 8*s.* 4*d.* In England the average salaries were higher for certificated teachers. Men head teachers earned, on the average, 173*l.* 11*s.* 2*d.*, and men assistants 124*l.* 7*s.* 3*d.* The amounts for women certificated teachers were 120*l.* 17*s.* 7*d.* and 90*l.* 3*s.* 8*d.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 23.—Sir Archibald Geikie, K.C.B., president, in the chair.—Miss M. **Robertson**: Trans-mission of flagellates living in the blood of certain fresh-water fishes. The goldfish in a pond at Elstree have for some years shown an infection of trypanosomes in their blood. Quite recently, trypanoplasma has also appeared. Upon investigation is was found that the leech *Hemiclepsis marginata* occurred in the pond, and effected the trans-mission of the parasites. A large number of these leeches were obtained from the Grand Junction Canal reservoir, which is only a short distance from the pond. The young of these were hatched out in captivity, and it was ascer-tained that the flagellates are not passed from parent to offspring. The parent leeches were invariably infected with trypanosomes derived from the fish in the reservoir, which frequently showed these parasites in their blood. The trypanosomes of perch, bream, and goldfish were found to complete their cycles in Hemiclepsis, and could be transmitted to clean goldfish by means of leeches. The specimens used in these experiments were always young laboratory-hatched Hemiclepsis. The trypanosomes of pike and rudd also complete their cycle in this leech, but the opportunity of passing these two forms into goldfish did not present itself. The cycles of the trypanosomes derived from these different sources are apparently identical. The main features are as follows:—The trypanosomes taken into the crop of the leech along with the blood multiply very rapidly, undergoing a marked change of form. After some days, slender forms begin to arise. These increase in number, and at the end of digestion, some time after the blood has quite disappeared, they come forward and lie in the proboscis-sheath in very large numbers. The form found in the sheath is a very slender, long creature of quite definite type; division has never been observed in this phase. When the leech feeds once more, these individuals are inoculated into the fish. The proboscis-sheath is always cleared of trypanosomes by one feed. After a clean feed the slender, inoculative type of trypanosome disappears from the crop of an infected leech, and the infection is carried on by short, broad forms. Conjugation has never been observed. If water is added to the blood of fish containing trypanosomes, the flagellates divide after a number of hours, probably in response to lowering of osmotic pressure in the fluid in which they find themselves.—Dr. B. B. **Boltwood**: Report on the separation of ionium and actinium from certain residues, and the production of helium by ionium. At the end of 1907 the Royal Society lent to Prof. Rutherford certain actinium residues, which were part of the material remain-ing after the separation of the radium by Messrs. Armet de Lisle, of Paris, from uranium residues acquired by the Royal Society. These residues, in weight 20 kilograms, contained a large quantity of lead, and were a very hetero-geneous mixture of elements. A preliminary examination made by Prof. Rutherford showed that actinium was present, and also a small quantity of radium. The amount of ionium, however, was much less than the theoretical amount to be expected if all of it had been removed with the actinium. The preliminary work of concentration was done by Messrs. Tyrer and Co., under the direction of Prof. Rutherford and Mr. Greenwood. This material was given to the writer for further concentration, and the paper

contains an account of the methods employed in the separation of the actinium and ionium. The ionium was finally obtained mixed with 1·8 grams of thorium oxide. The activity of this oxide, due to the ionium it contained, was about 3000 times that of an equal weight of uranium oxide. By counting the α particles from a thin film by the scintillation method, the amount of ionium present with the thorium was found to be equal to the amount in equilibrium with 5·3 milligrams of radium in a radioactive material. The actinium was finally concentrated to about 10 grams of material, which gave a final activity about 20,000 times that of uranium oxide. It was estimated that the amount of actinium separated was equivalent to the amount in equilibrium with 30 milligrams of radium in a mineral. Special experiments were made to test whether ionium was transformed into helium. The presence of helium was determined by its spectrum, and the volume produced was measured. The investigation showed that helium is produced by ionium as well as by all other products which emit α rays.—J. A. **Gray**: The secondary rays produced by β rays. Secondary γ rays are produced in different materials by the β rays of Ra*E*, the greater in amount, the greater the atomic weight of the radiator. The γ radiation observed from a preparation of Ra*E* can be greatly increased by a suitable disposition of the active matter and apparatus.—W. R. **Bousfield** and W. Eric **Bousfield**: The specific heat of water. The object of this investigation was to obtain a basis curve for the specific heat of water, for comparison with specific-heat curves of aqueous solutions. Former observers, using different methods, have obtained widely varying curves; thus for the specific heat of water at 80°, in terms of the 15° calorie, the following figures have been given, showing differences of 1 per cent.:—Barnes, 1·0014; Regnault, 1·0081; Lüdin, 1·0113. For the values in joules of the 15° calorie the following have been found:—Joule, 4·174; Griffiths, 4·198; Barnes, 4·184. The first part of the present investigation is concerned with the determination of the mechanical equivalent of heat in terms of the mean calorie from 13° to 55°, by a method of continuous-flow calorimetry. Mercury thermometers were used which could be read to 0·005°. An interval of 40° was taken, so that an error of 0·01° would not vitiate the result by more than 1 in 4000. Through a Dewar vessel containing about 3 litres of water, in which was an electric heater, there was passed a current of water, entering at about 13° and passing out at about 55°. The vessel was immersed in a bath kept at same temperature as contents of vessel. The top of the vessel was closed by a platinum box kept 10° higher. The electric heater, and the resistance used in series with it for determining the current by help of a battery of standard cells, were of novel type. Each consisted of a spiral glass tube of small bore, into the ends of which are sealed platinum electrodes. The tube is connected with a thermometer tube, so that the spiral forms a thermometer bulb. By calibrating the resistance against the reading of this thermometer tube, the resistance is accurately known, even when a current is passing. This type of resistance enabled the authors to surmount a difficulty apparently never considered by previous investigators. They have found that when a heavy current passes through an ordinary standard resistance, the resistance of the standard depends, not only on temperature, but also upon strength of current. This effect may be conveniently called the "thermoid" effect. The authors believe a liquid mercury resistance is free from any such effect. The continuous-flow experiments gave for distilled water $J_{13}^{55}=4{\cdot}182$. To get the curve for J from 0° to 80°, a weighed quantity of water was heated from 0° to 80° by stages which gave J_0^{13} J_{13}^{27} J_{27}^{25} J_{55}^{80}, the mean specific heats over the intervals. For this purpose, the capacity of the calorimeter was obtained from the value of J_{13}^{55} previously determined, and a separate research on the specific heat of glass was carried out in order to obtain the variation of capacity with temperature. From these an equation for the value J_0^{θ} was obtained, and then the value of J from point to point, from the equation

$$J=\frac{d}{a\theta}(\theta]_0^{\theta}),$$

The authors thus obtain

$$J=4{\cdot}2085-0{\cdot}003022\theta+0{\cdot}00007833\theta^2-0{\cdot}000000490\theta,$$

which gives for the value of the 15° calorie 4·179. [T]he resulting curve corresponds closely with that obtained [by] Lüdin by the method of mixtures, and differs considera[bly] from that obtained by Barnes by continuous flow w[ith] platinum thermometry.—Prof. C. **Niven**: The measu[re]ment of specific inductive capacity. The paper conta[ins] an account of work undertaken to determine the spe[cific] inductive capacity of liquids by the method of resonan[ce]. The frequencies of the discharge of condensers with [air] and with liquid as dielectric were compared by the cym[o]meter and dielectric constants of the liquids deduc[ed]. With some liquids, notably with water, the question [is] complicated by the conductivity of the liquid. The co[n]ditions of discharge through a conducting liquid are the[re]fore first determined, and the condition of resona[nce] between the two resonating systems found. This is sho[wn] to be of a simple character, reducing practically to wh[at] it would be if the conduction through the liquid w[ere] neglected. In some cases, water, for example, it [is] impossible to set up oscillations directly, but by int[er]posing in the circuit of the condenser another of consid[er]able capacity, the oscillations may be obtained. When t[he] capacity of this interposed condenser is relatively ve[ry] large, it has no appreciable effect on the frequency of t[he] oscillations produced, which are thus those of the liqu[id] condenser alone. Owing to the rapid variation of t[he] specific inductive capacity with temperature, spec[ial] arrangements had to be made to keep the liquid at [a] constant temperature while measurements were bei[ng] made. The results of a number of determinations [at] different temperatures are given for water and alcohol.

Zoological Society, February 7.—Prof. E. A. Minch[in], vice-president, in the chair.—Dr. W. N. F. **Woodlan[d]**: Structure and function of the gas-producing mechanis[m] ("red body") found in connection with the gas-bladd[er] of many teleostei (Physoclisti and Physostomi). Af[ter] summarising some of the principal facts known concer[n]ing these subjects, the author discussed various theori[es] already advanced to account for the details of gas-produ[c]tion, and showed that the most satisfactory hypothesis w[as] a combination of the views of Jaeger and of Nusbau[m] and Reis, supplemented by additional facts and sugg[es]tions then advanced in the paper.—Prof. J. C. **Ewar[t]**: Skulls of oxen from the Roman station at Newstead, M[el]rose. The author stated that examination of the sku[lls] from Newstead lent support neither to the descent of [the] European cattle from the Urus (*Bos primigenius*) nor [to] the descent of all European, Indian, and African bre[eds] from the Asiatic Urus (*B. nomadicus*). He dealt wi[th] the evidence to be derived from the maxillæ, the occipu[t] and the temporal fossæ, and stated his conclusions [as] follows:—(1) That the Celtic shorthorn (*B. longifrons*) [is] probably more intimately related to the zebu of Ind[ia] (*B. indicus*) than to the European Urus (*B. primigeniu[s]*). (2) That long premaxillæ are usually correlated with [an] occiput of the *B. primigenius* type, while short p[re]maxillæ are usually correlated with an occiput of t[he] *B. acutifrons* type. (3) That polled black Galloway cat[tle] and polled white "wild" Cadzow cattle are intimat[ely] related to the Urus, that flat-polled Aberdeen-Angus cat[tle] probably include amongst their ancestors an ancie[nt] Oriental race now represented by, amongst others, [a] Syrian breed with rudimentary horns, and that roun[d]-polled cattle may belong to a still more ancient Orient[al] race descended from *B. acutifrons* of the Punjab Siwalik[s]. —G. P. **Farran**: Copepoda of the family Corycæi[dæ] collected by Sir John Murray and Dr. C. W. Andrews [at] Christmas Island. The collection, though small in bu[lk], was exceedingly rich in species, and the genus Corycæ[us] was especially well represented. A new genus was pr[o]posed, and several new species were described and figure[d]. —H. R. **Hogg**: Some New Zealand spiders. The pap[er] was based on a small collection sent by Prof. Charl[es] Chilton, of Christchurch, New Zealand. Twelve speci[es] and eleven genera were represented in the collection, a[nd] a new local variety of *Tetragnatha ferox* and four ne[w] species were described.—Oldfield **Thomas**: Mamma[ls] collected in the provinces of Kan-su and Sze-chwa[n]

western China, by Mr. Malcolm Anderson, for the Duke of Bedford's exploration of eastern Asia. This collection, from a region hitherto almost unrepresented in the British Museum, was perhaps the finest that had ever come from China, at least so far as small mammals were concerned. Forty-seven species were included, represented by 350 specimens, presented, as on previous occasions, to the National Museum by his Grace.

Royal Microscopical Society, February 15.—Mr. Plimmer, president, in the chair.—E. **Heron-Allen** and A. **Earland**: New or rare species of Foraminifera found in the shore-sands of Selsey Bill, Sussex. The authors directed attention to the identity of the fossil Foraminifera of the Bracklesham beds with the living species found in Australian shore-sands. Recent specimens of *Bolivina durrandii* (Millett) and *Pulvinulina vermiculatis* (Brady) were shown, the only other known records being as regards the former from the Malay Archipelago and as regards the latter from tropical and subtropical seas. In addition to these, *Miliolina suborbicularis* and *M. rotunda*, *Dextuluria inconspicua*, var. *jugosa*, *Bolivina torterosa*, *Uvigerina asperula*, and *Sagrina dimorpha* were recorded as new to Britain. Schlumberayer's unique genus and species, *Hinderina brugesii*, was recorded from the Eocene clays, also the first fossil records of *Bulimina subtues* and *Discorbina polystomilloides*. The new species recorded were *Pulvinulina haliotidea* (H.-A. and E.) and *Nomionina quadriloculata* (H.-A. and E.). Microscopical specimens of these were also exhibited.—Lees **Curties**: A new dark-ground illuminator. This was made to the instructions of Mr. Nelson; it was so constructed as to work with slips ranging from 0·8 to 1·2 mm. in thickness, and gave a perfectly dark field with a Zeiss apochromatic 4 mm. lens of 0·95 N.A. The illuminator was provided with a fixed central stop, and also with a slot for utilising the apparatus as an oblique illuminator. A small dot placed on the front lens served for the purpose of centring the condenser to the optical axis.

Linnean Society, February 16.—Mr. H. W. Monckton, treasurer and vice-president, in the chair.—Mrs. L. J. **Wilsmore**: Some Hexactiniæ from New South Wales.—Rev. Canon **Norman**: Three species of harpactid copepoda.—The following papers were communicated by Prof. J. Stanley Gardiner:—Mr. **Hirst**: Report on the Araneæ, Opiliones, and Pseudoscorpiones.—G. A. **Boulenger**: List of the batrachians and reptiles obtained by Prof. Stanley Gardiner on his second expedition to the Seychelles and Aldabra.—Miss Mary J. **Rathbun**: The marine Brachyura from the Indian Ocean collected in 1905. It dealt with a large collection comprising 245 species and subspecies, 34 species and 3 subspecies being regarded as new to science, with 3 new genera. The results showed no connection with the West African crab-fauna.

Institution of Mining and Metallurgy, February 22.—Mr. Edgar Taylor, president, in the chair.—A. Beeby **Thompson**: The relationship of structure and petrology to the occurrence of petroleum. After describing the general structure of the important oilfields of the world, the author deals briefly with some of the local features which tend to modify the distribution of petroleum, as, for instance, the existence of faults in the strata, abrupt changes from oil-saturated sands to hard rock that is impervious to liquids, the lenticular distribution of oil sands, and the presence of water. Among the influences which have a bearing upon the distribution of oil in an operated field is the tendency of oil to follow certain channels, which probably represent lines of weakness that existed in the early ages of development, when high gas pressures were experienced. On this account, it is sometimes found that wells drilled at a later period in proximity to wells of large production will yield a comparatively small amount. In any case, the active development of a rich oilfield in which large volumes of gas are released must almost necessarily produce in course of time some changes in the distribution of the underlying petroleum. The author is at pains to show that with the development of oil sources are encountered some of the most wonderful and fascinating natural phenomena, and that no branch of mining is attended with greater interest or makes greater demands on the resources and ingenuity of the engineer in charge.—A. L. **Shrager**: Shaft sinking against water in fissured ground by cement injection. This paper comprises a brief description of a method of sinking shafts in water-bearing ground, the general result of which is practically to form a cofferdam of cement around the proposed site of the shaft. The particular shaft described in the paper was one sunk in a coalfield in the Pas de Calais basin, and full details are given, not only of the work carried out, but also of the cost, labour, and quantities of material involved.

CAMBRIDGE.

Philosophical Society, February 6.—Prof. Hobson in the chair.—J. J. **Lister**: The distribution of the Megapodidæ in the Pacific. The genus Megapodius consists, according to M. Oustalet, of some nineteen species. The distribution of fifteen of these extends almost continuously from Borneo to the New Hebrides and from the Philippine Islands to Australia. It thus covers an area in which the land masses are nowhere very remote from one another. There are, however, four outlying species far removed from the rest of the genus, namely, in Niuafou in the Tonga Group, the Pelew Islands, the Marianne Islands, and the Nicobar Islands. As the birds are incapable of long flight, the question arises, How is the distribution of the outlying species to be accounted for? It has been suggested that it may indicate the existence of a former land area by which all these remote islands were at one time connected. The object of this paper is to show that there is a good deal of evidence, negative and positive, to support the view that these outlying species may have reached their present habitats by the agency of the natives, by whom the eggs are highly valued as food. Niuafou is an active volcano 3½ miles in its longest diameter. The other birds inhabiting it are of species common to the Tonga Islands, though four, found in the other islands, are apparently absent from it. The birds are "protected" by the chief, and they exhibit a partial albinism, though in very varying degrees. The native name for the bird is *Mallow*, identical with that of the Solomon Island species and with that generally used by Malay hunters throughout the East Indies. The nearest species of the genus (in distance, but not in affinities) is that of the New Hebrides, some 900 miles to the west, no megapode being known from the intervening Fiji Islands, which consist of much larger and more ancient land masses. With regard to the Pelew Islands, Semper gives evidence showing that they consist of raised coral rock investing a volcanic basis formed by a submarine eruption in late Tertiary time. Quoy and Gaimard, the naturalists of the *Uranie*, visited the Marianne Islands in 1818–20, and state that the species there found was domesticated by the natives. M. Oustalet considers that there are undoubted affinities between this species and that from the Pelew Islands, and it is evident from the published figures that there is a close resemblance between the latter and the Niuafou bird. Wallace has expressed the opinion that the Nicobar bird has probably been introduced by the Malays. There is evidence that the species found in the Solomon Islands exists in some places in a domesticated or semi-domesticated condition. As the natives of the Pacific Islands were in the possession of fowls, dogs, and pigs when they were first visited by Europeans, the supposition that in some of their wanderings they may have carried megapodes with them, and thus established the outlying species in their present habitats, appears not improbable.—J. **Romanes**: Note on *Strongylocentrotus lividus* as a rock-borer. The specimen exhibited, which was collected on the west coast of Ireland, shows three echinoids occupying holes which they have excavated out of the solid rock. In cases previously described, the material which was removed appears always to have been much weathered. In this instance, however, the rock, which is a slate, is quite fresh, and as it is quite free from calcareous matter, the action must have been of a mechanical rather than a chemical nature.—A. J. **Grove**: Exhibition of sketches of a peculiar tracheal system of a mycetophilous larva (Diptera).

MANCHESTER.

Literary and Philosophical Society, February 7.—Mr. Francis Jones, president, in the chair.—Prof. W. Boyd **Dawkins**: The origin of the Roman numerals I.–X. It was suggested that these numerals were derived from a system of numeration employed by the inhabitants of Crete

during the Minoan civilisation. This conclusion was based on a comparison of the Roman numerals with a set of Minoan numerical symbols.—Prof. A. H. **Gibson**: The manner of motion of water flowing in a curved path. The conclusions which would appear to be justified as a result of the experiments described are:—(1) that whenever flow takes place past a curved solid surface, whether this is exposed to water on its concave or its convex side, the motion, except for the slowest velocities, is unstable; and (2) that in the fluid itself curvature with the velocity greatest on the *inside* of the path tends to stability, while curvature with the velocity greatest at the *outside* of the path tends to instability. Another fact which the experiments appear to indicate is that the tendency to eddy formation in the relative motion of a fluid and solid surface is greater, for a given relative motion, when the fluid, as a whole, is moving past a stationary surface than when the surface is moving through still fluids. This receives indirect confirmation from experiments by Stanton, Beaufoy, Froude, Dubuat, and Morin on the resistance of plane surfaces when moving through still water, or when held stationary in a moving stream.—Miss Margaret C. **March**: Studies in the morphogenesis of certain Pelecypoda. II.—The ancestry of the Gibbosæ. The ornament of the Trigoniæ, as shown by the ontogeny and phylogeny of modern species, develops from concentric to radial, with tuberculations developed on alternating radii. Fossil forms show the development of a third type of ornament, viz. diagonal by the junction of these alternating tubercles. Working from this basis, the Gibbosæ (part of the Glabræ, Lycett) can be traced back through the Undulata (Lycett) to the Triassic purely concentrically ornamented form *Myophoria curvirostris*.

DIARY OF SOCIETIES.

THURSDAY, MARCH 2.

ROYAL SOCIETY, at 4.30.—Reversal of the Reflex Effect of an Afferent Nerve by altering the Character of the Electrical Stimulus applied: Prof. C. S. Sherrington F.R.S., and Miss S. C. Sowton.—Carbon Dioxide Output during Decerebrate Rigidity (Preliminary Communication): Dr. H. E. Roaf.—The Alcoholic Ferment of Yeast Juice. Part VI. The Influence of Arsenates and Arsenites on the Fermentation of the Sugars by Yeast Juice: Dr. A. Harden, F.R.S., and W. J. Young.—Experiments to ascertain if certain Tabanidæ act as the Carriers of *Trypanosoma pecorum*: Col. Sir D. Bruce, F.R.S., and others.—Experimental Studies in Indian Cottons: H. M. Leake.

LINNEAN SOCIETY, at 8.—Dermaptera (Earwigs) preserved in Amber, from Prussia: Dr. Malcolm Burr.—Report on the Marine Polyzoa of the Collection made by Mr. J. Stanley Gardiner in the Indian Ocean in H.M.S. *Sealark*: Miss Laura Roscoe Thornely.—On the Mysidacea and Euphausiacea collected in the Indian Ocean during 1905: W. M. Tattersall.

RÖNTGEN SOCIETY, at 8.15.—Some Experiments with a 10,000 volt. Storage Battery: A. A. Campbell Swinton.

FRIDAY, MARCH 3.

ROYAL INSTITUTION, at 9.—Scents of Butterflies: Dr. F. A. Dixey, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lagos Harbour Survey, 1909–1910: H. Ellis Hill.

SATURDAY, MARCH 4.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

ESSEX FIELD CLUB, at 6 (at the Essex Museum of Natural History).—Further Notes on Moorlog, a Peaty Deposit from the Dogger Bank: H. Whitehead and H. H. Goodchild, with Notes on the Plants by Clement Reid, F.R.S.—Note on some Ichneumonstung Larvæ: Rev. W. K. Wyley.—Notes on *Plusia moneta* in Britain: C. Nicholson.

MONDAY, MARCH 6.

SOCIETY OF ENGINEERS, at 7.30.—Petrol Air-gas: E. Scott-Snell.

ROYAL SOCIETY OF ARTS, at 8.—Applications of Electric Heating: Prof. J. A. Fleming, F.R.S.

ARISTOTELIAN SOCIETY, at 8.—Knowledge by Acquaintance and Knowledge by Description: Hon. Bertrand Russell.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Industry of Brewing: A. C. Chapman.

VICTORIA INSTITUTE, at 4.30.—Psychology: Rev. Canon I. Gregory Smith.

TUESDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—Crystalline Structure: Mineral, Chemical, Liquid: Dr. A. E. H. Tutton, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Some New Siphonaptera from China: The Hon. N. Charles Rothschild.—(1) Contributions to the Anatomy of the Anura. I. Some Anatomical Notes upon the Frog *Megalophrys* (*Leptobrachium*) *feae*; (2) On the Spermatophores in Earthworms of the Genus Pheretima (= Perichæta): F. E. Beddard, F.R.S.—(1) A Rare Beaked Whale: (2) Age Phases of the Rorqual: R. Lydekker, F.R.S.—On Longevity and Relative Viability in Mammals and Birds; with a Note on the Theory of Longevity: Dr. P. Chalmers Mitchell, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Modern Railway-signalling: some Developments upon the Great Western Railway: A. T. Blackall.

WEDNESDAY, MARCH 8.

GEOLOGICAL SOCIETY, at 8.—Contributions to the Geology of Cyrenaica: Prof. J. W. Gregory, F.R.S., R. B. Newton, F. Chapman, and D. P. Macdonald.—The Teeth of Ptychodus, and their Distribution in the English Chalk: G. E. Dibley.

ROYAL SOCIETY OF ARTS, at 8.—Plague and its Dissemination: James Cantlie.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) The Absorption Spectra of Lithium and Cæsium; (2) Dispersion in Vapours of the Alkali Metals: Prof. P. V. Bevan.—On the Ionic Solubility-product: J. Kendall.—Note on the Electrical Waves occurring in Nature: Dr. W. H. Eccles and H. M. Airey.

MATHEMATICAL SOCIETY, at 5.30.—On the Reduction and Classification of Binary Cubic Forms which have a Negative Determinant: G. B. Mathews.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Laying and Maintenance of Transmission Cables: C. Vernier.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 9.—Recent Advances in Turbines: Hon. C. A. Parsons, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—On the Recent Species of Vulsella; on a New Species of Phasianella: E. A. Smith.—On the Value of the Gasteropod Apex in Classification: T. Iredale.—*Valvata Woodwardi*, n.sp., and *Sphærium Bulleni*, n.sp., from the Forest Bed (Cromerian) of West Runton, Norfolk: A. S. Kennard.

PHYSICAL SOCIETY, at 8.—Demonstration of the Working of the Gyro Compass: G. K. B. Elphinstone.—Note on an Electrical Trevelyan Rocker: Dr W. H. Eccles.—Notes on the Tilted Gold-leaf Electroscope: Dr. G. W. C. Kaye.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 9, 1911.

WHAT CONSUMPTIVES OUGHT TO KNOW.

(1) *Advice to Consumptives, Home Treatment, After-Care and Prevention.* By Dr. Noel Dean Bardswell. Foreword by Dr. C. T. Williams. Pp. xv+144. (London: A. and C. Black, 1910.) Price 1s. 6d. net.

(2) *Consumption, its Prevention and Home Treatment. A Guide for the Use of Patients.* By Dr. H. Hyslop Thomson. Pp. 75. (London: Henry Frowde, and Hodder and Stoughton, 1910.) Price 2s. net.

(3) *Open Air at Home: Practical Experience of the Continuation of Sanatorium Treatment.* By Stanley H. Bates. With introduction by Sir James Crichton-Browne, F.R.S. Pp. 62. (Bristol: John Wright and Sons, Ltd.; London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1910.) Price 2s. 6d. net.

(4) *The Expectation of Life of the Consumptive after Sanatorium Treatment.* By Dr. Noel Dean Bardswell. Pp. v+130. (Edinburgh, Glasgow, and London: Henry Frowde, and Hodder and Stoughton, 1910.) Price 3s. 6d. net.

ONE of the most important features of the modern crusade against consumption is the attempt that has been made by those who are actively engaged in treating patients in sanatoria to make provision for the training of these patients in suitable methods of carrying on home treatment, after-care, and prevention. These skilled men see that it is impossible for most of the patients who have come under their charge to remain in the sanatorium for a sufficient length of time to ensure complete or permanent cure, and they desire to make the sanatorium a school in which the patient may be trained so to live and regulate his work that he may become and remain a useful and productive member of society. No one is better able to give such advice than is Dr. Bardswell, the medical superintendent of the King Edward VII. Sanatorium, and in the little unpretending book (1) now before us we have in few words and practical form just such advice as the consumptive requires.

Dr. Bardswell begins by pointing out the difficulties of laying down general rules for the treatment of individual patients, but shows that when principles are sound the details can gradually be fitted in; the general principles as laid down by Dr. Bardswell are the following:—

"1. Raising the general health of the consumptive to its highest possible pitch, thus restoring his power of resistance and arresting the disease.

"2. Maintaining it there long enough to justify the assumption that the disease is cured."

Dr. Bardswell indicates that although the first part of the process may be effected during a stay of some three to six months in a sanatorium, the second portion of the cure rests with the patient himself, the twelve months following the patient's discharge from the sanatorium being the really critical period of treatment.

Fresh air, without cold or discomfort is his first requirement; open windows, shelters and châlets, half-holidays and holidays in the open, and a change of air whenever possible. Health resorts and sea voyages, if judiciously indulged in, may be very useful, but they are by no means essential, and, indeed, where they involve fatigue may be actually harmful. The chapter on food is extremely practical and very condensed, and those interested in the subject may well peruse it carefully. Dr. Bardswell is of opinion that the consumptive is best without any alcohol at all, though he thinks that when convalescence has been thoroughly established there may be

"no harm in substituting a glass of beer or some light wine for the milk at meals. This is as far as I would go. Spirit in any form and at any time, but especially so between meals, should be absolutely avoided."

In the suggestive chapter on rest and exercise it is laid down that anyone suffering from pulmonary tuberculosis, or who has so suffered, should abstain entirely from any game or sport which entails sustained and severe physical exertion or sudden and violent muscular effort, whilst the ordinary indoor recreations, unless they can be adapted to the open air in fine weather, should certainly be demitted during treatment and convalescence. Smoking, especially before meals, should be avoided except in great moderation. Moreover, if there is any tendency to weakness of the throat smoking is absolutely negatived.

It will be seen that Dr. Bardswell is essentially practical in directing special attention to those points concerning which the consumptive so often requires advice and encouragement. Hints as to clothing, an account of the sanatorium treatment, the principles of which have to be carried out in the patient's own after-life until health is thoroughly established, occupation, emigration, infection, disinfection, are all carefully dealt with. The last couple of pages give in concise and admirable form advice which will be useful not only to consumptives but to those who, without becoming valetudinarians, wish to remain physically and mentally sound and vigorous. The man who lives by the thermometer and with the help of various nostrums will find in this book nothing to encourage him, but the man who believes in good, sound, common-sense and a healthy, active life will derive great encouragement from its perusal.

(2) The reproach sometimes cast at the medical specialist, that he is too theoretical and pays but little attention to the practical details and surroundings of his patient, can certainly not be laid at the door of Dr. Hyslop Thomson, who, in a small compendium, gives a series of very practical hints which may be read with very great advantage by those who are recovering from consumption. This little work is another sample of the book that removes all excuse for ignorance, even amongst the laity, of the more important facts and factors to be noted and observed concerning the cause, course, treatment, and result of tuberculosis. Lowered vitality, inherited susceptibility, exposure to infection, the nature of infection,

are all treated of, and the special and general conditions under which tuberculous infection may be carried, and the conditions of the patients who may most readily be infected by that infective material are all of them laid down. The precautions to be taken against infection, the necessity for home treatment, and for the carrying of it out in a rational and intelligent and persevering fashion are insisted upon strongly. The following quotation might well be written up in large letters wherever men congregate:—

"The education of all consumptives to this view, that in the warfare against tuberculosis, the arrest of the disease, and the prolongation of life depend upon the care with which home treatment is carried out by the patient would materially aid in diminishing the death rate from the disease."

It is, of course, obvious that any such patient, if he be wise, will report himself at intervals to his doctor for examination and advice.

The various rules laid down as to observation of temperature, rest, exercise, diet, and the like, simple and readily followed out, are exceedingly valuable. The concluding paragraph of the book is perhaps a good type of the advice here given:—

"Too frequently the consumptive spends on useless nostrums money which would be far better employed in purchasing good food and procuring fresh air. All the so-called cures which are advertised for consumption will avail little in checking and curing the disease, compared with an intelligent effort on the part of the patient to carry out the principles and practices of open-air home treatment."

(3) Mr. Stanley H. Bates, in this brochure, gives a very succinct and clear account of his own experience in post-sanatorium treatment of consumption. Mr. Bates defines his purpose as being

"to give, in as clear a manner as possible, practical advice in the home-treatment of consumption drawn from three years' actual experience. It is written for the benefit of those who find themselves placed as I was three years ago, when, after six months at a sanatorium, I was advised to continue the treatment at home; and is an attempt to pass on to them the knowledge I should have been glad of then, but had to learn by experience."

After outlining the advantages of an outdoor sleeping shelter, the author gives a series of most practical details as to site, construction, and ventilation, protection from rain, materials, cost, and general construction and furniture, of an outdoor shelter. It is interesting to note how the ideas of the author gradually developed, and how at very small cost he has been able to evolve an open-air shelter that has practically all the advantages of a sanatorium shelter. He is a good example of the man who fights the disease whole-heartedly, and he certainly has deserved his victory.

"Wage continuous war with it," he says, "allow it no respite, and your victory will be accomplished the sooner. Some amount of moral courage and perseverance will be required for the purpose of your recovery. Energetic measures, however, and a determination to get well without delay, will go far towards rendering it sure and speedy. It is far better to make your recovery complete before returning to your occupation, than to run the risk of having to leave it again for the purpose of a further course of treatment. If your illness has upset your plans, make others; if a change of occupation is necessary, resign yourself to the form of life it will be best for you to follow. You will find more than sufficient compensation in the exuberance of health which you will enjoy as the result of your open-air principles."

This is good philosophy and sound common-sense. Mr. Bates's book should be in the hands of everyone who wishes to obtain the best results possible in his or her own care.

(4) Dr. Bardswell, in a concise abstract of the cases that have come under his observation in King Edward VII. Sanatorium, directs attention to the fact that it is now possible to obtain some indication as to the expectation of life of the consumptive, especially when based on a careful classification of a series of patients, living under favourable conditions, examined before and after treatment. He shows that this double classification is of importance because at the one extreme the patient is observed under what may be looked upon as the most unfavourable conditions, whilst at the other the course of the disease and the condition of the patient may be assumed to be considered in their most favourable aspects. How complicated and varied are the symptoms in cases of tuberculosis may be gathered from the classifications given by Dr. Bardswell, but it is obvious that without the data on which the classifications are based it would be impossible to give any intelligent and trustworthy prognosis, the classification on discharge being as important as is that on admission in so far that it offers additional ground for prognosis.

Marked differences persist at the stage of treatment, at which the cases leave hospital. This is evident from the fact that they are divided into "apparently cured," "arrested," "improved," "unimproved," or "progressive." Examining these cases at later intervals—that is, after periods of from one to five years—Dr. Bardswell gives the results of the open-air treatment of 241 cases discharged between the years 1901 and 1905, taking as the time basis of his report the year 1909, and points out that of these patients there were 62 suffering from incipient phthisis, of whom 46 were still alive, 6 of these dating back to the year 1901, 12 to the year 1902, 14 to the year 1903, 11 to 1904, and 3 to 1905, so that all of them were alive and well for at least four years after they had been discharged, and some of them for nine years. In only one case was the disease active when the patient was discharged, and he is now dead. Of the other cases of incipient phthisis 10 of the 62 were dead and four could not be traced.

Such results are certainly very satisfactory. In cases where the diseases was moderately advanced on admission the results were far less satisfactory. Of 95 treated 47, or 49·4 per cent. against 74 per cent. in the first group were well in 1909, 10 were alive, but were still suffering from the disease, and 35 or 36·8 per cent., against 17·6 in the first group were dead, and three patients had been lost sight of entirely. In the group in which the disease was far

advanced on admission, 84 in number, only 6, or 7·1 per cent., had been cured, that is, were well, in 1909. Only four others were alive, while 74, or 88 per cent., were dead.

It should be noted that Dr. Bardswell deals rather with what may be called the "chances of survival" than with the "expectation of life" as defined by actuaries. In regard to the capacity for work—that is, ability to work or to live an ordinary life—of the patients now described as well, he gives some interesting figures. Here, again, the incipient cases afford by far the greatest percentage of workers. Of those working at the above mentioned dates, it was found that 59 per cent. were able to do full work, 10·2 per cent. could work short hours, 10·2 per cent. had given up work, and 20·4 per cent. had died. From amongst the moderately advanced cases, 32 per cent. were doing full work, 7·3 per cent. were working short hours, and 24·5 per cent. had given up work entirely; 36·6 per cent. were dead. Of the advanced cases only 4 per cent. were working short hours, and 94 per cent. had died. The prospect of any advanced case ever doing a normal amount of work is, therefore, very small indeed; but, as Dr. Bardswell puts it, the "outlook for the moderately advanced cases is very fair and for the incipient cases good."

It is interesting to note that in a commentary on these cases Dr. Bardswell states that there are few morbid conditions that are so rapidly and markedly benefited by appropriate treatment as is tuberculosis, but that this treatment must be prolonged there seems to be little doubt, prolonged considerably beyond what the patient, from his feeling of well-being, usually considers necessary. At the same time, he believes that the patient may remain too long under sanatorium treatment. Some patients lose their self-reliance and become nervous as to their condition, and develop into "sanatorium hypochondriacs." These are usually the patients who do not obey instructions or who do not respond to treatment. Such patients, he believes, should go home or be sent abroad, and be encouraged to "get out of themselves" and find other interests.

Dr. Bardswell is also a great believer in the importance, as factors in success, of the temperament and character of the patient. He says:—

"To the consumptive who possesses earnestness of purpose, common-sense, courage, and patience, cure is much more probable than in one who lacks these characteristics. It has been well said that a fool never gets well of consumption."

Whatever else may be said, it must be admitted that the sanatorium treatment has prolonged by a very considerable span the life of the consumptive patient. Dr. Williams's estimate of the average duration of life of selected cases of consumption in the pre-sanatorium days was eight years. Dr. Noel Bardswell's figures indicate an improvement on this, for he finds that of every one hundred cases of consumption, taking them as they come, and without any attempt at selection, fifty will die within a period of from four to nine years after admission to the sanatorium, but the remaining fifty will be found for the most part to be enjoying good health after the same period. A study of the abstracts of Dr. Bardswell's cases seems to bear out his contention. This work may be commended to the attention, not only of those who expect too much from the sanatorium treatment, but also to those who are prone to belittle it.

EGYPTIAN RELIGION.

The Book of the Dead. By H. M. Tirard. With an introduction by Prof. E. Naville. Pp. 170. (London: S.P.C.K., 1910.) Price 3*s.* 6*d.*

THIS little book will no doubt interest the many amateurs of Egyptology in this country, but it cannot be said to be of any scientific value. For this it is too conventionally "religious" in tone; a cult of "one supreme God" is supposed to have existed amid the chaotic polytheism of Egypt (there is no proof of any such conception before the time of Akhenaten), and the commonplace belief in the immortality of the soul, which is shared by all mankind, is credited to the Egyptians as a special virtue. Also the book is not historical and archæological enough in treatment. We hardly realise from Mrs. Tirard's pages that the Egyptian religion had a long history, and that it was not the same at all periods; nor, to take a concrete instance, are we told by her that the *ushabti* figures, so typical of the interments of the dead, were unknown until half Egyptian history had been accomplished, their place being taken in the earlier ages by those remarkable models of workmen and boatmen which are among the chief treasures of our museums. All the typical prayers from "The Book of the Dead," about the *ushabtis,* the fields of Aalu, and so forth, which we regard as so characteristic of Egyptian religion, were not characteristic of it for half its period of existence.

The interest of the Egyptian spells and charms relating to the souls of the dead, which we call "The Book of the Dead," is to the anthropologist very great, as he gains from it most interesting views of the original savage state of the African ancestors of the Egyptians. But a strictly scientific book on these spells is yet to seek. A critical survey of the material would separate the early magical incantation from the later prayers and hymns of the civilised age. The pious conservatism of the Egyptians preserved the childish gabble of the primitive age side by side with the later prayers. Both are habitually jumbled up together in books on the Ancient Egyptian religious writings, and to the primitive magical gibberish is ascribed a hidden and recondite meaning (on the principle *omne ignotum pro magnifico*) which it never possessed. It never was more than the "patter" of the savage medicine-man. He was the spiritual ancestor, no doubt, of the cultured priests who wrote the hymn to Amen quoted by Mrs. Tirard (p. 157); but this is very far removed above the average calibre of "The Book of the Dead," of which it is no part, and seekers after real religious feeling in Ancient Egypt will go to these hymns and psalms, which have nothing to do with the tomb, its ghosts, and magical paraphernalia, the "clotted absurdities" to which Mrs. Tirard has devoted such careful and painstaking labour, which, however, has, we fear, hardly

been critical enough to be of any value to the anthropologist.

Prof. Naville is quite justified in congratulating (on the introduction which he prefixes to the volume) Mrs. Tirard on the extent of her knowledge of the Egyptian religious writings. It is her uncritical treatment of her own knowledge that we regret. There are few actual mistakes in matters of fact in the book, the most serious perhaps being the statement that the word *makheru*, "justified," is never used of the living, only of the dead; this is incorrect, as instances of *makheru* being used of the living are known. In a matter of faith rather than of reason, we do not share her belief that the "Prince of Wales's Feathers" are derived from the Egyptian feather symbolical of "Truth," or rather, "Right." Where are the intermediate stages between the old Egyptian feather-emblem and the day when the Black Prince did *not* take the three ostrich plumes from the helmet of the slain King of Bohemia? For we know that at Poitiers the blind king's crest was an eagle's wing, and that the picturesque legend of the origin of the Prince of Wales's Feathers has no basis in fact.

In her citations, Mrs. Tirard usually follows the masterly translation of Prof. Naville.

ANATOMY OF SEDGES.

Anatomy of the British Carices. By F. C. Crawford. Pp. xiv+124+xx plates. (Edinburgh: Oliver and Boyd, printed for private circulation, 1910.) Price 7*s.* 6*d.* net.

FRANCIS CRAWFORD was an enthusiastic worker in pursuits that attracted him; a remarkable man in that, after success in business enabled him to retire at forty-five, he could crowd so much acquisition of natural history knowledge and collections into the remaining twelve years of his life. Botanist, ornithologist, geologist—an all too brief biographical sketch of the author precedes the introduction by Prof. Balfour, who, as his lifelong friend, gives in a few touches fuller insight into the lovable character of the man. His sudden death, soon after the MS. was in the printer's hands, in February, 1908, deprived the work of the author's revision; and Prof. Balfour, who edited it, deemed it best, in spite of its unconventional phraseology, to let the book go forth "as Frank Crawford wrote it."

Crawford had no laboratory training, and, taking to botanical work late in life, could not readily acquire the use of its technical terms, or always consent to their fitness. "If people can't understand plain terms," he used to say, when his vernacular expressions were criticised, "so much the worse for them." This accounts for the frequent blend of scientific and homely phrases. The section of a midrib (p. 49) is described as a "round knob with a blunt point"; the stem of *C. remota* (p. 37) is "roundish and difficult to define, very bumpy"; the section of a leaf of *C. hirta* is "long, narrow, twisting about"; and in another species the "vascular bundles . . . don't reach to the epidermis." But these quaintnesses would not puzzle any reader.

What is a more troublesome deviation from usage will be found in the abbreviations and technical terms that need explaining, being relegated to casual footnotes. What is the meaning of the sentence on p. 8, "The bundle of *vulpina* var. *nemorosa* is in the median plane, but the patch of sch. does not reach to the apex, there is therefore a point of par."? The reader looks in vain for a list of abbreviations; it is in footnotes on pp. 2, 7, that to the two used here and constantly further on he finds a clue. The terms "involute" and "revolute" bear the meaning of incurved and recurved (p. 4), while "lumen" is not explained at all.

Such minor flaws detract, however, but little from the real value of an admirable book, which has the great merit of being pioneer work, at least in regard to this genus. The field botanist will be grateful for the inside details of stem, leaf, and rhizome, of which for the most part he has been woefully ignorant. All these details are set forth in the clearest style, in type that leaves nothing to be desired.

By Prof. Balfour's advice, Crawford tells us in his introduction, he collected, with the help of the Rev. E. S. Marshall and some others, fresh material to work on in preference to dried herbarium specimens. He first photographed a flower portion, and put other portions in spirit for winter work. From these he took sections of the stem, leaf, rhizome, and root, and prepared photomicrographs of the best, magnifying about 40 diameters. Little or nothing was obtained from dissecting the flowers; these are therefore not touched on in the "Anatomy." Many sections of the other parts were selected to figure, and with drawings of highly magnified stomata, &c., occupy twenty plates. These are done with a clearness of definition and a fidelity of detail that reflect great credit on both photographer and engraver.

The description of the figures in the plates, p. 115, is concise and accurate enough, but the numbers of the plates might have been added for convenience of reference, and as the species in this list of figures are in no order, and several occur again and again, the index should have embraced these pages as well as the rest.

In the special anatomy, as Crawford terms his descriptive account of the species, which forms the body of the work, each part of the plant in section (below the inflorescence) is given in detached paragraphs. *C. chordorrhiza*, Ehrh., is a capital example, being fully illustrated as well as minutely described. Crawford discovered in this species remarkable divergences between its aërial and underground rhizomes. There is no doubt where this came from, as there is but one British locality. The same with *C. trinervis*, which he collected at Ormesby by the present writer's direction. But the locality is a *desideratum* in almost every case, and might be supplied from the labelled specimens or photographs, which have been deposited at the Royal Botanic Garden, Edinburgh.

Most interesting is the success attained in differentiating more thoroughly the triad so perplexing to novices, *C. laevigata*, Sm., *binervis* and *distans*; in confirming on the whole the suspected origin of several hybrids, and in testing the claims of some varieties. Among these last the evidence does not

support the alleged distinction between *C. vulpina* and its var. *nemorosa*, *C. canescens*, and its var. *robustior*, *C. diandra* and its var. *Ehrhartiana*; shows some difference between *C. Goodenowii* and var. *juncella*, much more between *C. binervis*, Sm., and var. *Sadleri*, Linton, which are farther apart than has been supposed.

This posthumous work, which throws more light on the *Carices* than most of us expected, owes its inception and completion to its distinguished editor, but it is a fine memorial of the persevering toil and ability of its lamented author, which must find its way into the hands of every botanist who pretends to a knowledge of the genus.

EDWARD F. LINTON.

TABLES OF SYMMETRIC FUNCTIONS.

The Symmetric Function Tables of the Fifteenthic, including an Historical Summary of Symmetric Functions as Relating to Symmetric Function Tables. By Prof. F. F. Decker. Pp. 16+tables. (Washington, D.C.: Carnegie Institution, 1910.)

THE publication of this paper is an example of the excellent work that is being done by the Carnegie Institution of Washington, over a wide field of science, under the fostering care of Dr. R. S. Woodward.

The formation of Symmetric Function Tables dates from the first decade of the nineteenth century, when Meyer Hirsch gave them up to and including the 10^{ic}. These tables give the expression of a symmetric function of the quantities, $\alpha_1, \alpha_2, \ldots \alpha_{10}$, in terms of the elementary symmetric functions thereof, $p_1, p_2 \ldots p_{10}$, where

$$(x-\alpha_1)(x-\alpha_2)\ldots(x-\alpha_{10})=x^{10}-p_1x^9+\ldots+p_{10}.$$

According to modern notation and nomenclature a function

$$\Sigma\alpha_1^{\pi_1}\alpha_2^{\pi_2}\ldots\alpha_{10}^{\pi_{10}} \text{ or } (\pi_1\pi_2\ldots\pi_{10})$$

is thus expressed in terms of quantities

$$p_s=\Sigma\alpha_1\alpha_2\ldots\alpha_s \text{ or } (1^s),$$

the exponents of the quantities, α under the sign of summation being merely assembled in a bracket.

Ex. gr. $$(2^2)=(1^2)^2-2(1)(1^3)+2(1^4),$$

and it will be observed that each term on the eight involves four units, and each is said to be a separation of (1^4). Mr. Decker's tables, like the earlier ones to which he refers, express all the functions $(\pi_1\pi_2\ldots)$, where $\Sigma\pi=15$ in terms of separations of (1^{15}), and a reader of his historical summary might suppose that nothing further had been done in the way of tables of symmetric functions. The facts are quite otherwise, for several remarkable extensions have been made to which Mr. Decker makes no reference whatever. So far back as 1888, in the *American Journal of Mathematics*, an analogous theory was shown to exist in regard to the separations of any partition whatever, and a complete set of tables, direct and inverse, up to weight six inclusive, was given in the *Journal*; a law of symmetry corresponding to the Cayley-Betti law and several other laws of symmetry were established. For example, one row for weight six and the separable partition (321) is:—

$$2(51)=(3)(21)+(2)(31)-(1)(32)-(321).$$

It was also shown that the weight might be zero or negative, and the separable partitions involve zero and negative parts without interference with the construction of the tables or with their fundamental properties.

Further, also in the Phil. Trans., R.S., 1890, the tables and properties were extended to the symmetric functions of several systems of quantities and specimen tables were given. It is necessary to say so much, as otherwise a reader might be grievously misled.

The historical summary in regard to a single system of quantities and the separations of (1^n) is well given by Mr. Decker. He is in error in ascribing formulas for calculating the constituents in each of the first four lines or columns to Roe; the first of these is nothing more than Waring's law, extended by the law of symmetry; the others are readily obtainable from it, and have long been in use by calculators.

The chief use of the formation of tables of these functions has been that the construction has led to the discovery of new theorems which have been of use in other departments of mathematics; in particular, remarkable differential operators were thus brought to light which have been successful in opening up problems of the magic square description, which had defied analysts from Euler to Cayley. Also the theory of non-unitary symmetric functions was shown to involve that of the covariants of binary quantics.

It is disappointing to find that Mr. Decker's laborious work with the 15^{ic} has not resulted in the discovery of theorems of wide application; this is not surprising, because it is fairly certain that previous workers have taken the principal plums out of this particular orchard; but, this being so, there does not appear to be any sufficient reason for continuing this series of tables.

Mr. Decker's table is beautifully produced, and he seems, while detecting errors or misprints in the lower tables, to have carried out a good system of checks to ensure freedom from error in his own.

P. A. M.

WORKSHOP MATHEMATICS.

Shop Problems in Mathematics. By W. E. Breckenridge, S. F. Mersereau, and C. F. Moore. Pp. vii+280. (Boston and London: Ginn and Co.) Price *4s. 6d.*

THE authors' aims in producing this book have been to impart to the student information in regard to the more important points in shop work, such as the names of the parts of machines used in wood and metal working, together with the materials employed, and also to give a thorough training in the mathematical operations that are useful in shop practice and science. In carrying out these ideas, about two-thirds of the space available are occupied in calculations applied to timber, house building, machines, pattern-making, and foundry work, forgings, screws, and screw-cutting, and the gas engine. The latter part of the book is taken up with a review of calculation with short methods.

The book is decidedly American in its arrangement,

treatment, and nomenclature, and is evidently designed for the use of students in manual training high schools. One of the objects, we are told, is to correlate the work of the mathematical classroom with that of the departments of mechanic arts and science. For example, a student is beginning to handle boards in the shop and at the same time is commencing the study of algebra; it is advised that he be assigned some problems on board measure, together with a review of work in fractions. It is, without doubt, advisable to have a general working arrangement between the mathematical classroom and the applied science departments, but the arrangement, in our opinion, may be, and often is, carried too far. There is a danger, if the connection be too intimate, of the student specialising on his own account by giving his earnest attention to those portions of the mathematical work which are adapted to fit the trade he intends following, and giving scant attention to the other portions. It is rarely the case that books of the nature before us succeed in becoming an integral part of an effective educational system, despite the fact that they may be, as this one is, clearly written, full of useful information, and well arranged.

There are a few slips; thus on p. 107 appears an exercise on the work done while punching a hole. It is impossible to work this problem without an autographic record of the operation, although no hint of this is given. Many teachers in trade schools in this country will be glad to inform themselves of American methods through the medium of this book, despite the fact that they may find difficulty in placing it in their pupils' hands owing to the nomenclature, to which reference has been made.

SPECTROSCOPY.

Handbuch der Spectroscopie. By Prof. H. Kayser. Fünfter Band. Pp. vi+853+Täfel ii. (Leipzig: S. Hirzel, 1910.) Price 48 marks.

As is well known, Prof. Kayser planned to finish his great handbook in four volumes, but owing to the mass of the material dealing with absorption the third volume was divided into two. The same trouble has arisen over the fourth volume on the original scheme, and the present volume contains only the spectra of the elements, arranged in alphabetical order, down to and including nitrogen. The sixth volume, which is to appear shortly, will contain the spectra of the remaining elements, and will conclude the physical spectroscopy.

As Prof. Kayser points out in his introduction, it would have been very satisfactory to include under each individual element a complete account of the work that has been carried out on its spectra under varying conditions of illumination. This would have entailed, however, the expansion of the book by several volumes, and therefore the details that are given have been limited. In the case of the fifty elements dealt with in the present volume, tables of the wave-lengths of the lines in the arc and spark spectra are given, and there also appears an account of the work that has been carried out upon these spectra of each element. Although this has of necessity to be brief, yet Prof. Kayser has dealt with the various investigations in a critical manner. In one or two cases is this especially to be remarked, and the article on the spectra of carbon stands out particularly as a fine critical review of the many contributions to the literature of the subject.

One great difficulty faces anyone who attempts to collate the various measurements of the spectra of substances, and that is the question of the standards upon which these measurements are based. As is well known, for the eight years between 1885 and 1893, the standard generally employed was that of Ångström's map as corrected by Thalén; this was superseded by Rowland's normal solar spectrum, which differed from the previous one in an irregular manner. Later it was shown by Prof. Kayser himself that the coincidence method used by Rowland with his concave gratings is not to be depended upon, and this was borne out by Fabry and Perot, who proved by their celebrated series of interference measurements that the Rowland scale is also irregular in its accuracy. As a result of the discussion held at the meeting of the International Union for Solar Research, a new standard has been set up by Fabry and Buisson, based upon the interferential comparison of a number of equidistant lines with the Michelson cadmium standard. This, however, is too recent to have had very much influence on comparative measurements. As a result of the fact that the three standards are not capable of accurate comparison, it is easy to see that very great accuracy cannot at present be claimed for many of the published spectroscopic measurements. Prof. Kayser remarks that the accuracy cannot be depended upon to within 0·1 tenth-metre.

Another difficulty that is met with in collating emission spectra is the relative intensity of the lines. It is manifest that it is next to impossible to standardise these intensities, for they vary so much with the method of excitation and also with the sensibility curve of the photographic plate. Different experimenters, moreover, have used different scales to which the intensities are referred. The values given therefore can only be taken as a general guide to the brightness of the lines, and cannot be considered of much value in comparing the spectra of different elements.

There is no doubt that this volume is a very worthy follower of the first four in the series, and must prove an indispensable addition to the library of everyone interested in emission spectra. Above all, it shows the directions in which work, and that most important work, still remains to be done.

E. C. C. B.

OUR BOOK SHELF.

Subconscious Phenomena. By Hugo Münsterberg, and others. Pp. 141. (London: Rebman, Ltd., n.d.) Price 5s. net.

For the purpose of arriving at some unanimity, if possible, on subjects regarding which there exists a certain amount of diversity of opinion it has recently become the fashion among psychologists to write a *symposium* in which each contributor gives expression to his views. The present work, produced under the editorship of Dr. Morton Prince, is of this nature and

from it we learn what Münsterberg, Ribot, Jastrow, Prince, Janet, and Bernard Hart mean by the subconscious. That such a work serves a useful purpose may be gathered from the fact that, as the master of the symposium states in his introduction, there are six recognised meanings of "the subconscious":—

(1) That portion of consciousness which for the moment is outside the field of attention.

(2) Split-off or dissociated ideas, such as automatic writing.

(3) A subliminal, secondary, subconscious "self" constituted and elaborated from such dissociated ideas.

(4) A combination of dissociated and forgotten ideas.

(5) The subliminal reservoir of consciousness from which ideas are drawn into phenomenal consciousness.

(6) Certain neural processes unaccompanied by any mentation whatsoever.

Most of the writers take the view that subconscious phenomena are physiological and not psychical processes, the underlying reason in all being that they are not memories, ideas or anything else of which mentation is composed.

Janet, of course, limits the subconscious to such abnormal states as are encountered in hysteria and psychasthenia, and Bernard Hart considers that the marginal elements of phenomenal consciousness (the *subconscious* of Stout), dissociated portions of phenomenal consciousness (the *co-conscious* of Morton Prince and the *subconscious* of Janet) and the non-phenomenal conceptual *unconscious* of Freud all form part of the material of psychology and not of physiology. It need scarcely be said that a symposium by such writers is above criticism; they criticise each other.

Mikroskopische Untersuchungen über die Übereinstimmung in der Struktur und dem Wachstume der Tiere und Pflanzen. By Dr. T. Schwann. Edited by F. Hunseler. Pp. 242+iv Taf. (Leipzig: W. Engelmann, 1910.) Price 3.60 marks.

AT a time when the accumulation of the facts of animal and plant structure threatened to prevent a clear conception of their true value, this famous memoir by a distinguished pupil of Johannes Müller converted histology into a rational branch of science. Schwann, who effected this profound change, based his method on development. He pointed out that "there is a common principle of development for all the elementary parts of the organism," and in so doing founded (with Schleiden) the cell-theory upon which modern physiology and pathology are based. The cellular nature of animals and plants had already been demonstrated, but there was no general hypothesis to "colligate" the facts. This Schwann supplied. He not only confirmed facts of cellular structure, but, in a refreshingly broad way, and moving with the ease of genius amongst a multiplicity of data that would have bewildered a lesser mind, he brought forward the evidence for the origin of the tissues and enunciated clearly his views on the nature of life.

To Schwann the organism is a beehive, as Huxley said in his famous essay on this very treatise. Its activities are the expression of the myriads of cell-changes, each independent of all the rest. To Schwann, and almost against his better judgment, the organism was, indeed, the product of its cells, and its cell the result of the crystallising of a "cytoblastema." Though in some ways we have outgrown this essay, its influence will probably always be felt, and when histology, as to-day, has become incapable of large views from the overburdening load of descriptive data, we realise the need of another Schwann; let us be thankful for the physiologist who by his developmental hypothesis put the subject-matter into a definite problem and offered a feasible answer.

Determinación de la Latitud por la Observación de Distancias Cenitales de la Estrella Polar. By C. Puente. Pp. 227. (Madrid: Observatorio Astronomics de Madrid, 1910.)

THIS is a monograph on the method of determining the latitude of a place from observations of the zenith distances of Polaris, at a known time. There is nothing new in this method, which proceeds on the ordinary lines of developing the latitude in a series of ascending powers of the polar distance, but the author has put the discussion out with great clearness and considered very carefully the terms that must be taken into account, according to the degree of approximation needed, as well as the most suitable formulæ for use when Polaris is near the upper or lower culmination. The methods of observing by means of theodolites, the instrumental adjustments, and the precautions necessary to be taken to ensure accuracy are detailed with very great care, the instructions being evidently intended for those who have had little practice. Numerous examples are worked out by different methods, and we have the ordinary curiosity of a latitude determined to the hundredth of a second when the microscopes read only to half seconds, and the time is observed no nearer than a second. Some of the results are so accordant that the ordinary observer must despair of attaining a similar accuracy. The greater portion of the book contains auxiliary tables for accelerating the reduction. Some of these have been extended from Albrecht's "Formeln und Hilfstafeln für geographische Ortsbestimmungen." and are available only within the limits of the Iberian Peninsula.—The more important of the tables include values of $\frac{2\sin^2\frac{1}{2}t}{\sin 1''}$, $\log\frac{2\sin^4\frac{1}{2}t}{\sin 1''}$, also $\frac{\cos\phi\cos\delta}{\sin(\delta\pm\phi)}$ where t, ϕ, and δ have the ordinary signification.

Calculus Made Easy. Being a very simplest Introduction to those beautiful Methods of Reckoning which are generally called by the terrifying names of the Differential Calculus and the Integral Calculus. By F.R.S. Pp. viii+178. (London: Macmillan and Co., Ltd., 1910.) Price 2*s.* net.

THE author of this little book writes as if it were the first of its kind, and in encouraging his readers he continually jeers at the professional mathematician in what might be regarded as reckless nursery language. In spite of such faults, we have no doubt that the book will be useful to schoolboys who need the ideas of the calculus in their study of physical science. The young engineer or the clever schoolboy will think it illogical and slipshod to leave $(dx)^2$ *out of consideration, as it is inconsiderable* in comparison with the other terms of $(x+dx)^2$, and he will say that there is only a pretence in the proof of the differentiation of x^n; he will probably look upon the introduction of the expansion of $(1+1/n)^n$ when n is indefinitely great, as not quite playing the nursery game.

Einführung in die Biologie. Ein Hilfsbuch für höhere Lehranstalten und für den Selbstunterricht. By Dr. W. Schoenichen. Pp. viii+215. (Leipzig: Quelle and Meyer, 1910.) Price 2.60 marks.

IT is difficult to understand to whom this little book is intended to appeal. It might almost be described as a scrap-book of illustrations, borrowed mostly from other text-books, and strung together with a minimum of letterpress. The subject-matter is treated from the point of view of physiology rather than that of comparative anatomy, but there is a short section dealing with cells and tissues, and some extremely

inadequate descriptions of certain animal types. The geological history of the vegetable kingdom is dealt with in about half a page of text, but an entire page is devoted to "Lamarckismus und Darwinismus." This being so, it seems a piece of reckless extravagance to have devoted several pages of the section on movement to organisms which do not move. The appetite of the German public for small doses of extremely condensed elementary biology seems to be insatiable. We should like to know to what extent information conveyed in this way is capable of assimilation. It seems as if a considerable amount of previous biological training would be necessary, even for the intelligent reading of such a book as this. It may perhaps be of some use in supplying new points of view to those to whom the actual facts are already more or less familiar.

Heaton's Annual. The Commercial Handbook of Canada and Boards of Trade Register, 1911. Edited by E. Heaton and J. B. Robinson. Pp. 540. (Toronto: Heaton's Agency; London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price 5*s*.

THE information about Canada which a business-man requires is here arranged in logical sequence. All matter under the head of general information is official, having been collected from the latest Blue Books. The Boards of Trade Register contains descriptions of towns, with notes of opportunities offering for manufacturers, investors, and individuals. Altogether this is a useful work of reference.

Flowers of the Field. By the late Rev. C. A. Johns. Thirty-third edition, entirely revised by G. S. Boulger. Pp. 611+64 coloured plates. (London: Society for Promoting Christian Knowledge, 1911.) Price 7*s*. 6*d*.

NOTHING need be said about the interest and usefulness of a book which has reached its thirty-third edition. In its revised form this popular manual will probably enter on a new lease of life, for it would be difficult to find a more convenient volume for the student of field botany.

The British Isles: Geographical Diagrams and Land Forms, with Questions, Statistics, and Tables. By H. J. Snape. Pp. 64. (London: A. and C. Black, 1911.) Price 1*s*. 6*d*.

MOST teachers expect to find in the text-book of geography they place in the hands of their pupils maps, pictures, and statistics of the kind Mr. Snape has brought together here. In schools where it is difficult to use a magic-lantern, the pictures especially should prove useful. The book is likely to save teachers time and trouble.

Familiar Wild Flowers. Figured and described by F. Edward Hulme. Pp. xviii+184. (London: Cassell and Co., Ltd., 1910.) Price 3*s*. 6*d*.

THIS series of volumes—of which the present is the ninth—with their striking coloured plates, are already widely known and deservedly popular. It is easy with the aid of these books to decide the species and genus of common wild flowers, and to discover the part they may have taken in folk-lore and other literature. We understand this is the concluding volume of the series.

Junior Experimental Science. By W. M. Hooton. Pp. lviii+277. (London: W. B. Clive, 1910.) Price 2*s*. 6*d*.

THIS is the second edition of a book which on its first appearance was reviewed in NATURE for May 16, 1907 (vol. xxvi., p. 51). There do not appear to be any important changes in the volume.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

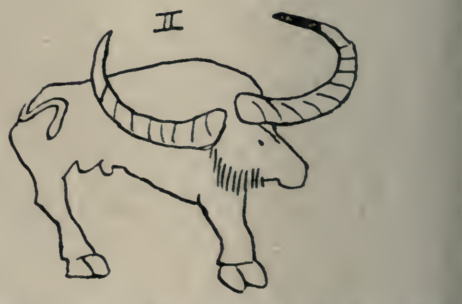
The Extinct Buffalo of Algeria as Drawn by Prehistoric Man.

ONE of my objects in making a tour recently into south-western Algeria and the adjoining region of the Moroccan Sahara was to see the engravings on the rock surfaces, which have lately attracted much attention amongst French men of science, especially those who are more or less connected with the University of Algiers. Quite a number of the sites of these remarkable rock drawings (such as Tiout and Zenaga) can be reached by the long railway which the State has constructed from Oran on the north to Figuig and the Wed Gir in the extreme south of Morocco.

These pictures on the rocks have been mainly studied and illustrated by M. Gautier (Mission Sahara: Le Sahara Algérien), and by M. G. B. Flamand, through the Lyons Society of Anthropology. M. Flamand's great work on the subject, however, is not yet completed for publication.

I

II



Prehistoric drawings of *Bos* (*bubalus*) *antiquus* in South-western Algeria. I, On rock-surface at Ennfous in the Aflou district, east of Géryville. II. At Ksar al Ahmar, near Géryville.

The chief features of interest in these prehistoric drawings will certainly be to zoologists the huge buffalo with enormous horns, which is perhaps the animal most frequently illustrated. I have copied a number of these either from the stones or the photographs of the stones, which may be seen at the University of Algiers or in the Algiers Archæological Museum, and give two of them here.

Of course, the great interest of these drawings is that they come as a valuable supplement to the palæontological discoveries made in the Quaternary and late Tertiary deposits of Algeria. The principal person connected with the discovery and illustration of the vanished fauna of Algeria was the late Prof. A. Pomel, whose works were mostly published between 1893 and 1908. Amongst the discoveries of himself or his predecessors were the remains of a gigantic buffalo—*Bos* (*bubalus*) *antiquus*—a creature

with a superficial resemblance to the Arni buffalo of India, but larger in size and possessing horns exceeding those of the Arni in length, while in its skeleton it evinces a greater relationship to the Cape buffalo. Of course, the fossil remains only give us in their most perfect examples the more or less complete bony core of these horns. We owe to the art of primitive man a better idea of what this armature looked like as a living animal. In full-grown males the horns were marked with annular corrugations, not unlike those still to be seen on the horns of Asiatic buffaloes (there are traces of them also in some of the modern types of Central Africa). There was no considerable development of horn boss on the forehead, and the horns seem to have been flat rather than round. They were set on the skull in such a way that they were not so much directed backwards, as in the Indian buffaloes of to-day, but branched out from the head almost at right angles to the median line of the nose, and in very extravagant developments looked like the figure 3 laid on its side. In some of the drawings there is the indication of the buffalo having developed a considerable fringe of hair along the angle of the lower jaw, in some examples almost a throat mane.

When did this large buffalo become extinct? Some of the authorities I consulted thought not more than two or three thousand years ago. They stated that amongst the engraved rock surfaces that have been photographed there are drawings of this buffalo bearing a pack-saddle. In any case, the drawings I saw myself represented it as being hunted by some form of white man (presumably of Libyan race) wearing a skin garment round the loins and armed with a bow and arrow, or with a spear and javelin, these weapons being either Neolithic or actually within the age of metal.

So far as I know, there is no mention of this buffalo existing in North Africa to be found in any of the Roman writers.

In addition to the buffaloes in these prehistoric drawings, the African elephant is the most striking feature. He is unmistakably delineated with widespread ears, but seldom or never with very big tusks. The fore-foot of these elephants is sometimes girt about by what seems to be a circlet of converging spikes (unless this type of elephant developed bristles on his feet). This recalls in appearance the kind of antelope or buffalo snare which is still in use in Ethiopia and East Central Africa. Other beasts illustrated on the rock incisions of Africa north of the Sahara Desert are the lion, leopard, Mhorr gazelle, Loder's gazelle, and domestic goats and sheep.

Among the remainder of the vanished fauna of Algeria which was apparently coeval with man, but is not to be identified in any prehistoric drawing, was a species of elephant closely allied to that of India, besides the *Elephas antiquus* of Pleistocene Europe. In addition to the buffalo, there was a large wild ox (*Bos opisthonomus*) allied to the aurochs of Europe, and a third form, *Bos ibericus*, apparently nearly related to the Indian zebu, and, if so, in all probability the parent of the modern domestic ox of negro Africa, as well as of types preserved for us in the art of ancient Egypt and of Crete. There was also an eland very like the elands of to-day, and what Prof. Pomel called a nilghai (*Boselaphus rayi*), with longer, more circular horns than those of the existing species; also a gnu, apparently related to the blue gnu of tropical Africa. There were two forms of hippopotamus, one the existing species, and the other a more primitive type with six incisors. Somewhat earlier, perhaps, in period of time was *Cervus pachygenys*, a remarkable form of deer with an exceedingly thick lower jaw, which developed on the outer aspect of its phalanges almost a boss of bone, the purpose or advantage of which does not seem to be very clear. Prof. Pomel also believed that he found in the recent deposits in Algeria a type of Palla antelope, besides an indigenous species of wild camel. As to the modern African elephant, it must have swarmed in Algeria down to the time of the Romans, say two thousand years ago. Its remains are discovered in nearly every watercourse in the northern littoral. The fossil remains on which the late Prof. Pomel's treatises were based can be seen (on application) at the museum of the University of Algiers.

H. H. JOHNSTON.

The Transference of Names in Zoology.

A LETTER on the above subject addressed to NATURE of January 26 by my friend, Dr. Calman, has appeared also in the American journal *Science*. This appeal to the Old World and the New evidently invites discussion. The letter apparently has in mind the man in the street and the natural history specialist, each of whom is to be protected from "moral and intellectual damage," which some applications of the law of priority might inflict upon him.

So far as the general public is concerned, two things should be borne in mind, first, that for popular books on natural history the publisher thinks one Latin name as bad as another, or a great deal worse, and, secondly, that the casual inquirer, when told the technical denomination of an animal, straightway forgetteth what has been told him, be it right or wrong, time-honoured or brand-new. Some handy little names might be kept in stock to gratify these incurious curious persons, as, for example, *Metoponanaphrissontes*, probably applicable to quite a crowd of creatures from annelids to monkeys. Tears seem to mingle with the ink when Dr. Calman tells us that "at present, a writer who mentions Trichechus may be referring either to the walrus or the manatee." Yet what sort of a writer could have the ingenuity to leave it an open question which of the two animals he was discussing? "The great possibility of confusion" to which Dr. Calman refers appears to me to be simply a nightmare, by which he himself is one of the last men in the world to be terrified.

Incidentally, I would beg Dr. Calman and others not to be scared into using Carcinides (Rathbun, 1897) as the generic name of the common shore-crab, assigned to Carcinus by Leach in 1814. It is quite true that Latreille in 1796 named a genus Carcinus in the Amphipoda, but this ought to be considered a *nomen nudum*, since no species was designated as belonging to the genus, and in the course of 115 years no one has fitted the definition to any amphipod in particular.

The conclusion of Dr. Calman's letter reopens a controversy which I will now make one more effort to close.

No crustacean, perhaps, is better known than the common lobster. May I earnestly ask leave here to set forth in full the credentials of its proper scientific name?

1758. *Cancer gammarus*, Linn., Systema Naturæ, tenth edition, p. 631.

1758. *Astacus verus*, Borlase, Natural History of Cornwall, p. 274.

1777. *Astacus gammarus*, Pennant, British Zoology, vol. iv., p. 9.

1791. *Cancer (Astacus) gammarus*, Herbst, Krabben und Krebse, vol. ii., part i., p. 42.

1798. *Astacus marinus*, J. C. Fabricius, Suppl. Entom. Systematicæ, p. 406.

1813. *Astacus gammarus*, Leach, Edinburgh Encycl., vol. vii., p. 398.

1815. *Astacus gammarus*, Leach, in Trans. Linn. Soc., vol. ii., p. 344.

1819. *Astacus gammarus*, Leach, in Samouelle's Entomologist's Comp., p. 95.

1831. *Astacus marinus*, Latreille, Cours d'Entomologie, p. 379.

1836. *Astacus gammarus*, Westwood, in Partington's Brit. Cycl. Nat. Hist., vol. ii., p. 167.

1838. *Astacus gammarus*, Westwood, The Entomologist's Text-book, p. 101.

1844. *Astacus marinus*, O. G. Costa, *Atti R. Acc. Sci.*, vol. 5, part ii., p. 72.

1850. *Astacus gammarus*, White, Catal. Brit. Crust., p. 35. With the imprimatur of John Edward Gray.

1857. *Astacus gammarus*, White, Popular History of Brit. Crust., p. 101.

1875. *Astacus gammarus*, Sowerby, Malac. Podoph. Brit., text to pl. 35.

1893. *Astacus gammarus*, Stebbing, Hist. Crust., Internat. Sci. Ser., vol. lxxiv., p. 203.

1897. *Astacus gammarus*, A. O. Walker, Rep. Brit. Assoc. (1906), p. 437.

1897. *Astacus gammarus*, Stebbing, Ann. Nat. Hist., ser. 6, vol. xix., pp. 120, 355.

1900. *Astacus gammarus*, Stebbing, South African Crust., part i., p. 34

1901. *Astacus gammarus*, T. Scott, Brit. Assoc. Handbook Nat. Hist., Glasgow, p. 330.

1906. *Astacus gammarus*, T. Scott, Proc. Roy. Phys. Soc. Edin., vol. xvi., No. 4, p. 116.

1906. *Astacus gammarus*, Stebbing, Victoria Hist. Cornwall, Crustaceans, p. 269.

We have now to consider the significance of these references. There is general agreement at present that the marine lobster and the river crayfish must stand under separate generic names. The question is, Which of the two has a right to that name Astacus, which for many years they enjoyed in common? Miss M. J. Rathbun argues that this was determined in 1810 by Latreille, who in his "Consid. gén. sur les classes des Crustacés," &c., gives a "Table des genres avec l'indication de l'espèce qui leur sert de type," citing for Astacus only *Astacus fluviatilis*. How little Latreille intended by this choice of an illustrative species to strip the lobster of its ancestral title may be inferred from his remark in 1803 that the *astakos* of Aristotle is evidently the marine lobster, and from the fact that still in 1831 he retains lobster and crayfish together in the same genus. Suppose, however, that in such matters a man's intentions are of no consequence, and that only his actions count, the same rule will apply in the case of Borlase, who in 1758 mentions only one species of Astacus, and that the common lobster, thanks to the fact that the river crayfish was not, and seemingly still is not, found in the county of Cornwall. But really the man to whom the restriction of Astacus is due was not Borlase, nor yet Latreille, but William Elford Leach, who in 1815 detached from it Nephrops for the Norway lobster, and in 1819 Potamobius for the river crayfish.

There is talk about lists of *nomina conservanda*. Lists of *exempla vitanda* would be much more to the purpose. Here is a specimen. Leach having previously restricted Astacus to the lobster, Milne Edwards in 1837 unlawfully transfers that name to the crayfish already named Potamobius, and endows the lobster with the new name Homarus, of which it was in no need. In 1852 Dana (U.S. Expl. Exp., vol. xiii., p. 532) follows suit, although acknowledging that "Leach has undoubted priority," but for various fanciful reasons setting that claim aside. He informs us that "in some recent English works the name Potamobius has been substituted for Astacus, and Astacus for Homarus," just as if it were the English works that had committed the crime of substitution, and he winds up his argument by saying, "There seem, therefore, to be reasons enough for rejecting Leach's names, if it is of no weight that they remained for thirty years unrecognised by British authors." Yet John Obadiah Westwood was a British author.

Then Huxley in 1881 ("The Crayfish," third edition, p. 13) tells us that Astacus was retained for both lobster and crayfish until Milne Edwards (in 1837) called the lobster Homarus. "At the present time, therefore," he continues, "while the recognised technical name of the crayfish is *Astacus fluviatilis*, that of the lobster is *Homarus vulgaris*," though he admits that by *astakos* the Greeks, ancient and modern, mean the lobster and not the crayfish, and Huxley himself, while ignoring Leach's Potamobius, accepts and defines (pp. 252, 256) a family Potamobiidæ. In 1888 Spence Bate (*Challenger* Macrura, p. 192) follows in the wake of Dana, with some additional statements, of which my references will supply a sufficient refutation. Thus these distinguished men bolster up one another in wrong-doing, and feebly lament the supposed necessity of doing wrong. At a time when British natural history was at a very low ebb, and natural history at the British Museum had little to be proud of, Leach suddenly threw lustre alike on that institution and on the science of his country. Need we be surprised if John Edward Gray and Adam White and James Sowerby felt the honour of Leach bound up with that of the great museum to which they also belonged? They followed the lead of the famous Westwood in vindicating the claims of Leach. For English-speaking carcinologists on either side of the Atlantic now to aid and abet in the transference of Aristotle's Astakos and Leach's Astacus to a different genus will be unscholarly and unpatriotic, as well as a needless breach in the law of priority.

Thomas R. R. Stebbing.

Tunbridge Wells, February 24.

Time Accuracy in Magnetic Registration.

Some contributions by Dr. Bauer and Mr. Faris in the last volume of *Terrestrial Magnetism* have given rise to a number of letters in this journal concerning the starting times of magnetic disturbances and the accuracy in the determination of time on magnetograms. Mr. Walker (No. 2147, p. 236) points out that the accuracy is augmented by interrupting both curve and base line. This is evident; the beams of light reflected by the various mirrors of the variometers towards the horizontal cylindric lens have, in general, different inclinations, the spots of light on the paper have different heights, so that the interruptions in different traces do not lie on a line perpendicular to the base line. Dr. Krogness (No. 2145, p. 171) desires rapid registering with automatic time marks upon the curve itself, in order to solve the question of simultaneity or non-simultaneity of the abrupt beginnings of magnetic storms for different parts of the globe.

For a number of years, an arrangement answering Dr. Krogness's wishes has been applied at the Meteorological Institute at De Bilt (Netherlands); the method was described for the first time in the Annuary B. for 1905, and recently in *Terrestrial Magnetism* (vol. xv., p. 31, 1910) in a communication concerning the magnetic storm of September 25, 1909. By means of a contact clock, the circuit of a battery is closed for two seconds every minute; the current illuminates a little glow lamp, the filament of which is straight and placed vertically. This filament takes the place of the illuminated slit in the usual arrangement of an Adie magnetograph; its image, about ½ mm. wide, would be formed in the plane of the paper. Just in front of the paper, however, a screen with narrow, horizontal slit is mounted; accordingly, only the light admitted through the slit falls on the paper, and we get a little line or spot about ½ mm. long and ¼ mm. wide. Every minute such a spot is formed; an hour corresponding to 15 mm. of base line, the recorded curve consists of a series of points with a mutual distance of ¼ mm. Another contact lights the glow lamp every twenty minutes for four seconds; this contact falls between two minute-contacts, and is convenient in reading the time. The correction and the rate of the contact clock, and consequently the times of the contacts, are exactly known; the moments of the twenty-minute contacts are 0m., 20m., and 40m. Greenwich mean time.

On quiet or moderately disturbed days the trace looks at first sight as a continuous curve; at times of larger disturbances the points are further apart. With the usual arrangement, in strongly disturbed parts the trace becomes very faint, or is sometimes altogether lost; this drawback may be avoided by taking a wide slit, but then many details in quiet or less disturbed parts of the curve are lost. The new method of registration enables the variations to be followed exactly from minute to minute in all circumstances; it must be granted, however, that some details, *e.g.* rapid oscillations of small period, are not exactly reproduced by this method.

The contacts being given once every minute, the beginning of a disturbance, which, as a rule, falls between two contacts, is known with an accuracy of ½ minute; the uncertainty may be reduced, however, to ¼, ⅙, or $1/2n$ minute by giving the contacts 2, 3, or n times a minute; there is no objection against doing so, only the velocity of registration should be taken greater 2, 3, or n times respectively.

It is evident that the method described shows some analogy with that for seismic registration; here too a time mark is given generally once a minute by a contact clock. These clocks being kept for sale, among others, by the manufacturers of seismographs, the arrangement of magnetic registration in the manner applied at De Bilt is a rather easy matter. For the solution of various problems recently advanced—simultaneity or non-simultaneity of the abrupt beginnings of magnetic storms for different elements, direction and velocity of propagation, and character of disturbances, &c.—the providing of a number of stations, spread over the globe in an appropriate manner, with registering apparatus of the kind described, would undoubtedly yield important data and results.

G. van Dijk.

Meteorological Institute, De Bilt, February 21.

Reflections in Water.

IN the coloured photographs from Egypt, printed in *The Illustrated London News* on February 25, one picture has white clouds and blue sky with their reflection in still water. The image has the appearance of being stronger than the original. The fact is that the blue sky has much more polarised light than the clouds: the cross-polarisation by reflection at the water darkens the sky and scarcely alters the clouds. At the various incidences, by which the different points of the sky reach us, the conditions are altered. Thus the reflected scene is one of greater variety and stronger contrasts. The effect is not due to anything in the photographic process; I was surprised to see such a correct presentation of what I have sometimes observed.

No one could surpass the late Lord Tennyson in his love for noting various moods of nature, but perhaps the habit is more frequent with great masters of language in France than with us. Pierre Loti abounds with such passages as "Avec cette sonorité particulière que les cloches prennent pendant les nuits tranquilles des printemps." Rostand devotes the opening verses of "Chantecler" to the varied powers of sunlight: the sinking sun, for instance, which chooses

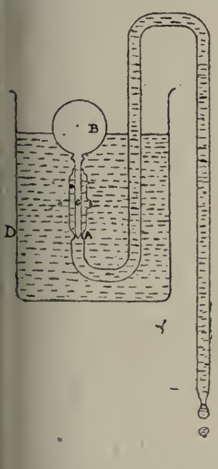
L'humble vitre d'une fenêtre
Pour lancer son dernier adieu.

There are two marked forms in which we often see this. Sometimes it is difficult to believe that there is not a fierce red fire raging in a distant house. At other times, with a higher and a whiter sun, a house on the hill may reflect the sun to us, surrounded with brilliant coloured halos. I suppose that dust upon the window diffracts the light, as do the dust plates of Fraunhofer.

The College, Winchester. W. B. CROFT.

A Self-regulating Siphon.

IN a large number of laboratory experiments it is necessary to keep a continuous flow of water through a vessel in which the level must remain constant. Some sort of self-regulating siphon is a great convenience for this purpose, and that here described is both simple in construction and very efficient in use.



The **U**-tube, bent out of ordinary quarter-inch quill tubing, as shown in the sketch, is narrowed at the point A, and the small piece of glass rod, C, is drawn out so as to fit this constriction. The bulb B, sealed on to the top of this rod, floats on the surface of the water. The **U**-tube must be so fixed that when the water is at the desired level the rod just fits into A, and so closes the exit. If the level of water in the vessel D rises at all, the bulb is raised, and the excess of water flows out through the siphon.

W. H. TAIT.

King Edward VI.'s High School, Birmingham.

The Plumage Bill.

THE statement has been widely circulated by a section of the Chamber of Commerce interested in the feather trade that the aigrettes or ospreys which are now worn are, for the most part, the moulted plumes collected after the breeding season. Long ago Prof. Alfred Newton exposed this statement. He emphatically stated that "cast" feathers do not find their way into the market, and added, "I should doubt whether cast feathers have any real value at all in the plume trade," his belief being that no one concerned in it would look at them. Again, Mr. W. H. Hudson wrote:—"Each bird produces only a small number of these valued feathers, and when he sheds them he does not shed them all together in some spot where a feather-hunter will be sure to find them. He drops them one by one at odd times, some falling in the water where he fishes, some among the trees and rushes where he roosts, and some are shed when he is on the wing going from place to place."

Sir E. Ray Lankester, Mr. W. P. Pycraft, and Mr. James Buckland testify to the truth of the foregoing. Sir E. Ray Lankester says:—"It is always the parent bird, slain at the breeding season, which supplies 'ospreys' for women's hats and bonnets. . . . I am quite tired of assuring the public of the facts of the matter."

In introducing his Bill to prohibit the sale, hire, or exchange of the aigrette and other plumes, Mr. Percy Alden stated that last year some thousands of ounces of these plumes were offered for sale at Mincing Lane. It is estimated that this amount represents the breeding plumes of about 20,000 parent birds, the fledglings of which were probably left to die of starvation. Legislation is the only means of coping with this insensate massacre. JOSEPH COLLINSON.

York House, Portugal Street, W.C., February 28.

Edward Blyth and the Theory of Natural Selection.

WITH reference to Mr. H. M. Vickers's letter in NATURE of February 16, I may perhaps mention that the Edward Blyth who edited Gilbert White's "Selborne" in 1836, a reissue of which was made in 1858, dated his "advertisement," or preface, from "Lower Tooting, November, 1836." Blyth's bird notes to this edition are extensive, but the other portions of the book are very free from annotation. EDWARD A. MARTIN.

285 Holmesdale Road, South Norwood, S.E.

Cat Playing with Shadow.

CAN any correspondent of NATURE recall a case of a cat playing with a shadow?

I know of a cat—a blue Persian—which appears to wait until the morning sun throws the shadow of a cage-bird on the wall of a room, and then seems to play at catching the shadow of the bird as it moves about.

H. S. G.

22 Kensington Park Gardens, W.

THE A-KAMBA OF BRITISH EAST AFRICA.[1]

MR. HOBLEY has again put ethnologists in his debt by giving another series of observations on certain tribes of British East Africa. His monograph on "Eastern Uganda: an Ethnological Survey," published by the Royal Anthropological Institute in 1902 was followed in 1903 by a valuable paper, "Anthropological Studies in Kavirondo and Nandi," in the *Journal* of the Institute. In the present volume he deals mainly with the A-Kamba, who inhabit a large area south and south-east of Mount Kenia, and about whom we have hitherto had extremely little information, with the exception of a capital general and comparative ethnographical account by J. M. Hildebrandt in the *Zeitschrift für Ethnologie*, Bd. x., 1878, p. 347. A small book containing vocabularies of the Kamba and Kikuyu languages, compiled by Mrs. Hinde, was published by the Cambridge University Press in 1904, but no details are given about either people.

The A-Kamba are probably the purest representatives of the Bantu stock in British East Africa; they are a sturdy people, the males being about 5 feet 6 inches in height. The average cephalic index of ten men is 78·6, while that of two skulls is 74. The nose is platyrhine. Two general types of head are noticeable, one "with very wide massive jaws, curved sides, and tapering towards the forehead, a very coarse negroid type, and the other is, comparatively speaking, a more intellectual type, with a wider fore-

[1] "Ethnology of A-Kamba and other East African Tribes." By C. W. Hobley, C.M.G. Pp. xvi+174. (Cambridge: University Press, 1910.) Price 7s. 6d. net.

head and narrower in the region of the jaws; the chiefs generally belong to the latter type. It appears to be impossible to discover any reason for this variation." Periodically numbers of the younger people are seized by a peculiar form of hysteria (resembling the so-called arctic hysteria), and the sight of a hat or cap, or sometimes of a dog, causes the patient to fall into convulsions, until the obnoxious object is removed from sight. The numerical proportion of the sexes is equal, and polygyny is fast dying out. The A-Kamba are the only people in East Africa who chip the upper incisor teeth to a point; filing or chipping the teeth is generally supposed to be associated with cannibalism, but so far as can be ascertained no such custom exists or has existed among the A-Kamba. The ornaments, clothing, implements, arts and crafts of the people are succinctly described, but the most valuable portion of the book is that dealing with the social and religious aspects of native life. The birth, marriage, and death customs are recorded, but those connected with puberty are of greater interest. Circumcision is performed when the child is about four or five years old; this is only a small affair, but more important is an initiation ceremony, which lasts for several days, at which several hundred young people are often present; the boys and girls are divided into batches of ten or fifteen, with a fully initiated youth or girl in charge of each batch. It is the duty of these tutors to teach their pupils their duties in life; they also cut pictographs on sticks, the meaning of which the neophytes have to discover. Some two months later the youths only undergo a ceremony of a very secret character in the woods; in the darkness of the night a weird booming roar is heard, and the youths sit and shudder with fright. This is said to be caused by a fearsome beast, which on the third day is supposed to be killed and its flesh eaten by the novitiates. Very little is known about this ceremony, which is evidently one of great antiquity and interest.

FIG. 1.—Pictographs cut on a stick representing a star; moon; arrow; black, red-legged millipede; python, the dots represent the spots on the reptile's skin; spider; tortoise; lizard; wooden jar for carrying honey. From "Ethnology of A-Kamba and other East African Tribes."

FIG. 2.—Matungi, chief of the Mogogodo tribe. From "Ethnology of A-Kamba and other East African Tribes."

The second part of the book contains some valuable notes upon a few other tribes; of especial importance are the notes on the social organisation of the Masai, among whom a geographical grouping is replacing the older clan grouping; the marks branded on the cattle correspond to the latter, while the designs on the shields have a territorial significance. Mr. Hobley directs attention to the promising field for research, not only in the ethnology but in the archæology of British East Africa. His little book, which is extremely well illustrated, serves to emphasise how much more there is to be done; for example, he has discovered a new small pastoral tribe, the Mogogodo, on the foothills on the north side of Kenia, who possess a remarkable language, and features that remind one of certain ancient Egyptians. In a prefatory note, Prof. Ridgeway strongly endorses the remarks of Mr. Hobley on the importance of Government officials having a preliminary training in anthropology.

A. C. HADDON.

THE TOKYO IMPERIAL UNIVERSITY.

THE peoples of the West for a long time had the impression that while the Japanese had great artistic ability and could imitate the productions of other countries, they had little or no originality. Notwithstanding all that they have accomplished during the past forty years or so, both in the arts of peace and war, that impression still prevails to a considerable extent, and we frequently hear opinions which do not do justice to their general ability, their trustworthiness, or their originality. It would take us too far afield if we attempted to disprove those opinions from what the Japanese have accomplished, but a perusal of the reports of the Minister of State for Education and of the calendar of Tokyo Imperial University shows that the developments which have taken place in Japan in recent times are not the superficial veneers which some people would have us believe they are, but, on the contrary, that they have been made on a solid foundation of education.

The annual report of the Minister of State for Education is a most interesting document, and shows that during the time which we have mentioned every department of education which is necessary to train men and women for all the duties of a modern State has been very fully developed. Elementary schools are to be found in every part of the country, and secondary schools have been established in the more important centres of population, while a great variety of special and technical schools, fit for all the functions required under the new conditions, which are the result of the adoption of Western science and habits of life.

At the head of all these educational institutions stand the Universities of Tokyo and Kyoto, the calendar of the former of which has just come to hand, and a perusal of it will be useful to all who are interested in education in this country, as in some respects it shows a width of view and a completeness of arrangement which are not always observable in universities in this country. The University of Tokyo began in a very small way, and its development is sketched in the interesting historical summary which serves as an introduction to the calendar. At a comparatively early stage it had four departments of study, namely, those of law, science, literature, and medicine, and in 1886 the Kobu-Daigakko or Imperial College of Engineering, became a college in the university. Readers of Nature of between thirty and forty years ago will remember this as the college associated with the names of Dr. Henry Dyer and Dr. Edward Divers, its first and second principals, and of Profs. Ayrton, Perry, Milne, and other graduates of British universities.

The university now consists of six colleges and one university hall. The colleges are those of law, medicine, engineering, literature, science, and agriculture. The College of Law includes the two courses of law and politics, with thirty-four professorial chairs. The College of Medicine includes the two courses of medicine and pharmacy, with thirty-one professorial chairs. In connection with this college there is a course of State medicine. The College of Engineering includes the nine courses of civil engineering, mechanical engineering, naval architecture, technology of arms, electrical engineering, architecture, applied chemistry, technology of explosives; and mining and metallurgy, with thirty-two professorial chairs. The College of Literature includes the three courses of philosophy, history, and literature, with twenty-four professorial chairs. The College of Science includes the nine courses of mathematics, astronomy, theoretical physics, practical physics, chemistry, zoology, botany, geology, and mineralogy, with twenty-five professorial chairs. The College of Agriculture includes the four courses of agriculture, agricultural, chemistry, forestry, and veterinary medicine, with thirty professorial chairs. For the training of practical farmers, subsidiary courses of agriculture, forestry, and veterinary medicine are provided in connection with the College of Agriculture.

The university is well equipped with all the appliances required for the practical teaching of the various subjects. It has a very good library, containing a large number of all the more modern books required in university study. Hospitals are connected with the College of Medicine. An Institute of Historical Compilation is a part of the College of Literature connected with the College of Science are the Tokyo Astronomical Observatory, the Botanical Garden, the Seismological Observatory, and the Marine Laboratory. Forests, experimental farms, veterinary hospitals, and the Institute for the Training of Agricultural School Teachers are connected with the College of Agriculture. There are many laboratories and museums in connection with the Colleges of Medicine, Engineering, Science, and Agriculture.

The total number of students is between five and six thousand, and of graduates in one year nearly nine hundred. The record of the occupations of the graduates after they have left the university shows that they have taken up practical work connected with the special department which they had selected as students. A large proportion become Government officials, lawyers, engineers, medical practitioners, and teachers. There are two private institutions in Tokyo of university rank, the Keio Gijiku and the Waseda Universities, each of which has a large number of students, the majority of whom enter private services, as distinguished from the students of the Imperial University, a large proportion of whom become Government officials.

That the students of the university do not simply absorb Western learning and apply it to practical purposes is shown by the long list of papers which is printed at the end of the calendar, giving the contents of the *Journals* of the Medical, Engineering, Science, and Agricultural Colleges, and the bulletins of the Engineering and Agricultural Colleges. Those who have had the opportunity of perusing these publications will admit that they will bear very favourable comparison with those of similar publications in any other country, and those who have the pleasure of knowing the professors personally will admit that they are men of ability, learning, and character, of whom any learned institution in the world would have no reason to be ashamed.

A survey of the results of education on the affairs of the nation shows convincingly and conclusively the intimate relation that exists between the provision made by a nation for the higher education of its people and the position taken by that nation in the ceaseless competition between the great countries of the world. After a searching comparison between the facilities for university education in this country, on one hand, and in the United States and Germany on the other, Sir Norman Lockyer was justified in saying in his presidential address at the British Association meeting at Southport:—

"But even more wonderful than these examples is the 'intellectual effort' made by Japan, not after a war, but to prepare for one. The question is, Shall we wait for a disaster and then imitate Prussia and France, or shall we follow Japan and thoroughly prepare by 'intellectual effort' for the industrial struggle which lies before us?"

H. D.

FIFTH MIGRATION REPORT OF THE BRITISH ORNITHOLOGISTS CLUB.[1]

We have before us the fifth annual report of the migration committee of the British Ornithologists Club, containing the data with regard to the arrival and dispersal within England and Wales of our common migratory birds during the autumn of 1908 and the spring and early summer of 1909, scheduled and tabulated as in former years. The report, which is longer than any of its predecessors, summarises a vast number of observations sent in by numerous voluntary observers, and by the keepers of the coastwise lighthouses and lightships. These data, compiled with an infinitude of labour and care, will always retain their value as a contribution to our knowledge of the movements of the species dealt with within the narrow limits of the area of reference. Even such apparently dry details—composed solely of names and figures—present (among those, for instance, sent in from the lonely sea-girt stations dotting our shores from The Hanois to St. Abbs Head) an interesting and fascinating picture of that wild, inexplicable rush of our feathered friends in a commingled horde fleeing as from judgment to come, which every autumn blindly compels to the southward, but to what latitudes we know not yet for certain.

The dates of the movements of the scheduled birds tabulated on the maps afford us again the satisfaction of following the sure and happy return of our

[1] Bulletin of the British Ornithologists Club. Edited by W. R. Ogilvie-Grant. Vol. xxvi., Report on the Immigrations of Summer Residents in the Spring of 1909; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1908. By the Committee appointed by the British Ornithologists Club. (London: Witherby and Co., 1910.)

summer songsters as they hasten hard after the northing sun. The tale each map is intended to tell is made evident on its face by a system of signs, but they are intelligible, however, only to those acquainted with the earlier reports. As the student may not always have these at hand, it would be advantageous and would save some "language," if the editor would, as already suggested in Nature of May 26, have the interpretation of the hieroglyphical brackets inserted in the preface or cause explanatory legends to be attached to each map; for the signs have not invariably the same meaning in all of them, while occasionally new signs are introduced without explanation, such as the hexagons and octagons which are used in the present report.

There is considerable inconsistency also in the plottings of the observations. In some schedules the earliest arrivals, even if solitary, are entered, but not invariably: in others, movements mentioned in the chronological summary, which appear to us to be of importance, are ignored for no obvious reason. In the diary of the swallow, for instance, the summary includes a large number of records for May, yet the whole of them (with the exception of those for "2," "7–14," and "3," on the south coast), although numerous and apparently as important as those of March and April, are entirely unscheduled. So far, also, as appears from the map, there was in 1909 only a single swallow immigration, yet the summary alludes to several, and in previous years as many as five are separately mapped. In the section entitled "Unscheduled Birds," sixty-six birds are recorded, and are listed in many cases with fuller details than those given for the scheduled species. It would be an advantage to those studying the evidence, we think, if, in future reports, both scheduled and unscheduled birds were incorporated in one list, the latter in less prominent type, if need be. There is as much to be learned from the one set as from the other. It would, likewise, be important and very interesting to have lighthouse records for the arriving as well as for the departing bird-streams, and to know if the spring flocks are composed of as mixed assemblages of species as those of the autumn. It would be worth trying also to ascertain whether, if this be not the case on arrival, it be so as they start from their winter quarters.

Those who have followed this inquiry will remember that the reports which the committee have presented during the last five years are but fuller continuations of the investigations carried on for so many years by a British Association committee. The present committee, in their second report, hoped "that in a few years results of considerable value may be obtained." Many ornithologists are of opinion that if these elaborate and costly compilations are ever to contribute to the solution of the migration mystery some results ought by now to be showing on the surface. Yet if we search through the four last reports, we fail to discover any fact of real significance which is not to be found in the first. The dates of the arrival and departure of our migrants are seen to vary slightly from year to year; the wave may be larger or smaller, and the species which make their port of entry in one year east of the Isle of Wight may choose one to west of it in other years. But of what importance is this information to the problem? Five years ago it was believed that the methods adopted by the committee would probably provide material for valuable generalisations. Year after year passes, and our disappointment grows that we seem no "forarder" in our quest. It is becoming daily clearer that the area of observation is far too limited, for the land-patch of England and Wales is no more to the wide area covered by migrants than Trafalgar Square is to the county of Middlesex. The complex problems—the cause of the impulse, whether it originates within or outside the birds, and whether it affects all species, though in different degrees: how the young birds (if in autumn they really—which is very questionable—precede their parents into uncharted space) find their way, and other such questions, cannot be solved by tabulating the momentary vision of a passing bird in association with local meteorological or other conditions which it encounters by chance *en route*, except over a wider area than these reports deal with, and by taking many other influences into consideration.

We firmly believe that no contributions of real value to this inquiry can be attained, if they ever are to be attained, except by the united international action of ornithological societies in marking vast numbers of parents as well as nestlings in their breeding localities, of "the thousands" also of those that are temporarily dazed at lighthouses, and of northern species while in winter quarters in various regions of Africa, and of southern Asia and America. Only thus are we likely to discover what awakens the migratory impulse at a particular date, whether meteorological changes, deficiency of food supply, decrease of sun-heat and light, or other external causes, or whether none of these have any influence, and perhaps solely an inherited periodical brain-storm impels them to the road. Only by the capture of birds, numerously marked at their nesting-places in northern and in their winter quarters in southern latitudes, can their routes, out and home, be plotted and dated with any approach to exactitude. Such an inquiry must needs be protracted even with united world-wide interaction; but it seems more hopeful than any other. Moreover, it is urgent, and ought to be commenced at once. The mystery of migration may, nevertheless, elude the best efforts of our generation towards its solution.

JOHAN GADOLIN.[1]

JOHAN GADOLIN, one of the most distinguished of Finnish men of science, occupies a well-defined position in the history of chemistry. He was a pupil of Bergman, a friend of Scheele, and the forerunner of Berzelius. He served as a connecting link, as it were, in the new departure of the science as initiated by the workers at Upsala, and as so splendidly furthered by the secretary of the Stockholm Academy. Gadolin's scientific activity was, in fact, concentrated within the two decades which elapsed between the death of Scheele and the coming of Berzelius, and his labours worthily upheld the traditions of the Scandinavian school.

Gadolin came of a family which had long been associated with learning and scholarship in Finland. He was born June 5, 1760, at Åbo, then the capital of Finland, and the seat of its university. His father, Jacob Gadolin, was formerly professor of physic, afterwards of theology, and ultimately Bishop of Åbo. His maternal grandfather, Johan Browallius, a contemporary and friend of Linné, had also served as professor of physic, and, like his son-in-law, was likewise made a bishop. After passing through the High School of his native town, the young Gadolin attended the lectures of Pehr Adrian Gadd, the first to hold a chair of chemistry in the Finnish University. Attracted by the fame of Torbern Bergman, then one of the foremost leaders of chemical science in northern Europe, he passed over to Upsala, where he remained four years. During that time he became known to Scheele, and was on terms of intimate

[1] Johan Gadolin, 1760–1852. In Memoriam. Wissenschaftliche Abhandlugen Johan Gadolins in Auswaht. Herausgegeben von Edv. Hjelt und Robt. Tigerstedt. Pp. cii+287. (Leipzig: S. Hirzel, n.d.) Price 12 marks.

friendship with him during the few short years of life that were left to him.

Gadolin was the most distinguished of Bergman's pupils. Under him he began the metallurgical and mineralogical inquiries with which his name is associated. At Upsala, too, he commenced his work on specific heat, which he subsequently published at Åbo in 1784. On the death of Bergman, he was a candidate for the chair at Upsala, but Afzelius was chosen, whereupon Gadolin returned to Finland, and in 1785 was made professor extraordinarius at the University of Åbo. The duties of his office left him, however, ample leisure, part of which he occupied in travel in Germany, Holland, and England. He established a literary connection with Lorenz Crell, which led to frequent communications to the *Annalen* which Crell edited. Whilst in London he published a memoir on the analysis of iron ores by wet methods, in which he gave the first suggestion of a method of volumetric analysis, and in conjunction with Crawford he undertook a series of determinations of the latent and specific heat of ice. Passing over to Ireland, he made the acquaintance of Kirwan, with whom he subsequently corresponded on mineralogical matters.

Gadolin was early attracted to the work of the French School of Chemistry, and made known the new doctrine to northern Europe. On his return to Åbo in 1789 he adopted the new chemistry as a feature of his teaching. In 1797, on Gadd's death, he became ordinary professor of chemistry, holding the chair until 1822, when he retired. Phlogistonism died hard in Sweden, but Gadolin's handbook, which he published in the Swedish language in 1798, did much to kill it. The most fruitful period of Gadolin's scientific activity is comprised between the years 1788 and 1803.

It was Gadolin who first made known the existence of a new earth in a black mineral from Ytterby, in Sweden, which Ekeberg subsequently termed *Yttria-earth,* the first discovered member of that numerous group of bodies we term the rare earths. The mineral itself became known as Gadolinite. A hundred years later Marignac and Lecoq de Boisbaudran found a new element in Samarskite, which they named *Gadolinium,* in honour of the discoverer of the first of this series of substances.

The great fire of 1827, which practically destroyed Åbo, and with it the university buildings and the whole of his mineral collections, terminated Gadolin's scientific career. The site of the university was moved to Helsingfors, and Gadolin retired to the country, where he died on August 15, 1852, at the age of ninety-two.

In the handsome quarto volume before us Prof. Hjelt and his collaborator have put together a very complete account of Gadolin's career and of his services to science. This is followed by copious extracts from his correspondence, some details of his courses of university lectures, and a selection of his more important memoirs, and the whole concludes with a list of his contemporaries, more particularly of those associated with him as academic colleagues, coworkers in science, or as literary correspondents. The chapter on Gadolin's scientific activity contains an admirable critical account of his relation to his period and of the part he played in connection with the downfall of phlogistonism. It also contains a full and discriminating analysis of his more important memoirs, viz., on specific heat, on iron analysis, and on his detection of the first member of the series of rare earths. The short acount of his system of teaching is largely made up of extracts from the manuscripts of his lectures. They are especially rich in historical references and throw interesting sidelights on his period.

T. E. T.

NOTES.

We notice with deep regret the announcement of the death, in his fifty-ninth year, of Prof. J. H. van 't Hoff, honorary professor of general chemistry in the University of Berlin, on February 1, at Steglitz, near Berlin.

The nineteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered on Wednesday, June 28, by Dr. F. H. Hatch, his subject being "The Past, Present, and Future of Mining in the Transvaal."

The president of the Royal Society and the members of the General Board of the National Physical Laboratory will meet at the laboratory on Friday, March 17, for the annual visitation, when the various departments will be on view.

Prof. H. E. Armstrong, F.R.S., has been nominated the delegate of the Royal Institution at the celebration of the centenary of the Royal Frederick University of Christiania, and Sir James Crichton-Browne, F.R.S., as delegate at the celebration of the 500th anniversary of the University of St. Andrews.

Lieut.-Colonel David Prain, F.R.S., director of the Royal Botanic Gardens, Kew, has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

It is announced in the *Revue scientifique* that M. Fauvel has offered 30,000 francs for the construction of an annexe to the laboratory of the National Museum of Natural History in Paris.

The death is announced, at sixty-eight years of age, of Mr. John Sime, C.I.E., late Director of Public Instruction in the Punjab and Under-Secretary to the Punjab Government in the Education Department.

We regret to notice that Mr. E. E. Wilson, formerly an assistant in the radiography department of the London Hospital, died on March 2 as the result of disease contracted by frequent exposure to Röntgen rays.

The Easter excursion of the Geologists' Association will be to St. David's district, South Wales, and will extend from April 13 to April 22. The excursion directors are Mr. J. F. N. Green and Prof. O. T. Jones, and the excursion secretary Mr. A. L. Leach, Giltar, Shrewsbury Lane, Plumstead, S.E.

A conference of members of the Museums Association and others interested in museums will be held at Belle Vue and Bankfield Museums on Saturday, April 8, for the purpose of discussing subjects of interest to those concerned in the work of museums, art galleries, and kindred institutions. Anyone proposing to attend the conference should communicate with Mr. H. Ling Roth, Briarfield, Shibden, Halifax.

Dr. John W. Harshberger, assistant professor of botany in the University of Pennsylvania, has just returned from an expedition in the Everglades of southern Florida, during which he collected several plants previously unknown to science. The Everglades themselves, he reports, are fast passing away through continual drainage, and their vegetation is likely soon to become extinct.

We learn from *Science* that the U.S. Senate has passed the Weeks Bill providing for the establishment of a forest reserve in the Appalachian Mountains. The Bill is applicable from Maine to the Gulf of Mexico, on the eastern

seaboard. The Bill gives the consent of Congress to the States to enter into an agreement among themselves for the purpose of conserving the forests and water supply of each, and grants 40,000*l*. to enable the Secretary of Agriculture to cooperate with such States in giving fire protection. In addition, the Bill appropriates 200,000*l*. for one year, and not more than 400,000*l*. for each year thereafter, until 1915, for surveys, examinations, and acquirement of lands located at the headwaters of streams which are being or may be developed for navigable purposes.

A FLIGHT from Paris to the crest of the Puy de Dôme was accomplished by M. Eugène Renaux on a Maurice Farman biplane with a passenger on March 7. The distance is 210 miles, and the journey was made to the crest of the Puy de Dôme, 4000 feet high, in 5h. 11m., after one landing. This is the fourth noteworthy aëroplane flight of the present year, the others being :—January 30, Mr. McCurdy, the Canadian aviator, flew over-sea from Key West (Florida) to within ten miles of Havana, in the island of Cuba; February 1 and February 2, Captain Bellanger flew from Paris to Pau, *via* Bordeaux, a distance of nearly 500 miles; March 5, Lieut. Bague flew 140 miles over-sea from Nice almost to the Italian coast. Referring to these flights, *The Morning Post* says :—" These flying achievements, viewed in regard to the lengthy periods over which they were sustained, the precision with which they were executed, and the fact that in each case the aviator had a definite goal which he succeeded—or all but succeeded—in reaching, place the art of aviation in a position, as concerns its practical usefulness, which it would have been all but impossible to have foreseen only a year ago."

THE following are among the lecture arrangements at the Royal Institution after Easter :—Prof. F. W. Mott, two lectures on the brain and the hand; Prof. W. W. Watts, two lectures on (1) the ancient volcano of Charnwood Forest (Leicestershire), (2) Charnwood Forest and its fossil landscape; Prof. R. W. Wood, three lectures on the optical properties of metallic vapours; Dr. W. N. Shaw, two lectures on air and the flying machine : (1) the structure of the atmosphere and the texture of air currents, (2) conditions of safety for floaters and fliers; Mr. T. Thorne-Baker, two lectures on (1) changes effected by light, (2) practical progress in wireless telegraphy; Mr. W. P. Pycraft, two lectures on phases of bird life : (1) flight, (2) migration. The Friday evening meetings will be resumed on April 28, when a discourse will be given by Prof. W. M. Flinders Petrie on the revolutions of civilisation. Succeeding discourses will probably be given by Prof. Martin O. Forster, Prof. W. Stirling, Prof. R. W. Wood, Prof. Gilbert Murray, Commendatore G. Marconi, and Prof. Svante Arrhenius, among others.

THE first Universal Races Congress will be held on July 26–29 in the central building of the University of London. The object of the congress will be to discuss, in the light of modern knowledge and the modern conscience, the general relations subsisting between the peoples of the West and those of the East, between so-called white and so-called coloured peoples, with the view of encouraging between them a fuller understanding, the most friendly feelings, and a heartier cooperation. The following is the programme for the eight half-day sessions :—(1) fundamental considerations—meaning of race, tribe, nation; (2–3) general conditions of progress; (3*a*) peaceful contact between civilisations; (4) special problems in inter-racial economics; (5–6) the modern conscience in relation to racial questions; (7–8) positive suggestions for promoting inter-racial friendliness. It is proposed to hold in connection with the congress an exhibition of books, documents, photographs of the highest human types, skulls, charts, &c. The exhibition is under the direction of Dr. A. C. Haddon, F.R.S., and promises to be of wide interest. A prospectus will be sent free of charge on application to the honorary secretary of the congress, Mr. G. Spiller, 63 South Hill Park, Hampstead, London.

MR. L. PEARSALL SMITH writes to *The Times* to suggest that another term, such as " halcyon "—used as a substitute—should be adopted in the place of " anti-cyclone," as this word is said not to convey the connotation of calm and pleasant weather conditions. " While popular speech," he remarks, " has been able to adopt ' cyclone,' it has found, as we might expect from its form, ' anti-cyclone ' unsuited for its purpose." The unfortunate thing is that popular speech, as expressed in the daily Press, calls a storm or any unusual atmospheric disturbance a cyclone, whereas it is nothing of the kind. What Mr. Smith proposes, therefore, is that the exact terms of meteorological science shall be modified to adapt them to the indefinite and often incorrect expressions of popular language. For the sake of the preservation of precision in scientific nomenclature, it is worth while to give in this connection a quotation from a publication of the U.S. Weather Bureau, issued many years ago :—" The terms ' cyclone ' and ' anti-cyclone ' do not describe phenomena that can be observed by one observer at a single station; they should, therefore, not be used in the description of local phenomena; they represent generalisations based upon the charting and study of winds and clouds observed at many stations, and should only be used when the nature of the rotation of the wind has been clearly demonstrated or can be safely inferred."

A SUMMARY of the temperature, rainfall, and bright sunshine in the United Kingdom for the past winter is given by the Meteorological Office in its last issue of the Weekly Weather Report. The mean temperature was slightly in excess of the average over the entire kingdom, but the difference was nowhere large. At Greenwich the mean for the three winter months, December to February, was 1·7° below the normal, but December is the only month where the departure from the average was considerable, amounting to an excess of 5°. The Midland counties is the only district in which the sheltered thermometer touched 60°, whilst the minima in the several districts fell below 20° everywhere except in the Channel Islands. The aggregate winter rainfall was deficient except in the north and west of Scotland and in the east and north-west of England. The greatest deficiency is 2·64 inches in the south of Ireland, and 2·22 inches in the Channel Islands. The largest aggregate rainfall for the three months is 17·37 inches in the north of Scotland, and the least 4·30 inches in the north-east of England. There was an excess of rain during the winter at Greenwich, due entirely to the heavy rains in December. The rainy days were in fair agreement with the average, the maximum number being 73 in the north of Scotland, and the minimum 46 in the north-east of England. The duration of bright sunshine was generally in fair agreement with the average over the whole kingdom, the records for England showing a slight excess. The maximum duration of sunshine is 209 hours in the Channel Islands, the minimum 103 in the north of Scotland.

WE learn from the Wellington (N.Z.) *Evening Post* of December 7, 1910, that the New Zealand Government has voted 50*l*. or 100*l*. towards the cost of explosives for rain-

making experiments to be made at Oamaru and adjacent drought-stricken parts. It has been shown that such experiments are a useless expenditure of money, and (as stated in the article) have been condemned by the best meteorologists of Europe and America. *Symons's Meteorological Magazine* (July–September, 1908) contains a careful report by Mr. D. C. Bates, who was ordered to watch and report upon rain-making experiments previously carried out in the same district. He states that "the explosions had apparently no more effect on the vast expanse of the air than would the striking of a match in a room." In a lecture printed in *Popular Science Monthly* for January last, Prof. C. Abbe, one of our leading authorities on meteorology, states, in connection with laboratory experiments on the formation of clouds and rain:—"I think you will see that the firing of cannon or dynamite in order to make a great noise is not likely to form rain, and, in fact, cannot possibly bring it down." And further, with reference to the cannon used in Italy to send vortex rings of air into the clouds, he says:—"We have no evidence that they ever reach them, or that they could have any effect if they did so. . . . I regret to think of so many thousands of farmers wasting time and money on this delusion"; and with these opinions we entirely concur. The situation was saved in the present instance by rain having fallen before the explosions took place.

THE thirty-third annual general meeting of the Institute of Chemistry was held on March 1. Dr. George Beilby, F.R.S., the president, occupied the chair, and delivered an address, in which, after referring to the losses of the institute by death, mentioning especially Prof. Campbell Brown, Mr. Michael Carteighe, and Mr. Oscar Guttman, he dealt with the progress and work of the institute. The membership continues steadily to increase, notwithstanding the high standard of the examinations, while the position of the institute as an organisation existing for public service never stood so high as at the present time. The council has under consideration the institution of a series of lectures, the object of which will be to bridge over the gap between academic training and practice. Without depreciating the value of a broad scientific education, it is realised that students entirely trained in an academic atmosphere miss some of the advantages of the old system of private pupilage in the laboratories of practising fellows or in works. This loss is met in some instances by students preparing for the final examination in such laboratories, but there is a need for a means of introducing something analogous to the clinical instruction afforded to medical students. It is proposed, therefore, to ask fellows having expert knowledge to give lectures which will give students an insight into the actual work of the chemist, whether engaged in the application of his science to commerce and industry or to the scientific control of the affairs of daily life. Prof. R. Meldola, in moving a vote of thanks to the president for his address, said it would give him much pleasure to see the institute take an active part in the education of chemists, and he cordially supported the new departure as to the institution of the proposed lectures, which will make the student realise more fully the value of the practical side of his subject.

IN *The Times* of March 4 there appeared a further article upon the subject of the spread of plague. Dealing, first, with the disease amongst rodents in East Anglia, the writer refers to the rat investigation recently carried out at Ipswich under the auspices of the Local Government Board. This inquiry lasted for about six weeks, during the course of which about 6000 animals were examined. These rats were not drawn from the area already known to be infected, but from a fairly extensive tract of country on its outskirts. No report has yet appeared, but it is believed that few, if any, plague-rats were found. This result, although apparently reassuring, does not affect the main question. The investigation was carried out during the off-plague season, and at the time when fewest rat-fleas are found. Similar inquiries carried out in India and elsewhere show that it is dangerous to conclude that plague has disappeared from an infected area because no plague-rats are found. It is thereafter desirable that the investigations should be repeated in autumn, and at intervals during the next two or three years. In the meantime, the campaign of rat extermination should be prosecuted with undiminished vigour. Reference is made to the proposal of the War Office to hold extensive manœuvres in Essex. While the possibility of infection among the troops must be considered remote, yet it cannot be said that the establishment of large standing camps is altogether free from risk. Turning next to the question of plague manifestations in other parts of the world, the writer of the article gives some important particulars concerning the occurrence of the pneumonic form of the disease during recent years. These show that a relatively large proportion of such cases occur in temperate climates. Very little is at present known about pneumonic plague, and there are often difficulties in its diagnosis. It is not unlikely that much valuable information may be obtained by a study of the present outburst in Manchuria. No explanation can be afforded for the mysterious disappearance of plague at the beginning of the eighteenth century, or for its equally mysterious reawakening in the Chinese province of Yunnan in the 'seventies of last century. Since the year 1896 it has caused a terrible loss of life in India, and spasmodic cases have occurred in every continent. It has been argued that the Manchurian outbreak suggests an increasing intensity in the violence of plague infection, the consequences of which will presently be universally manifest. Whether or not this be the case, there is ample justification for the statement that the outlook is not hopeful in places where the rodents are infected. Where infection exists there is always danger. Panic would be unwise, but no one acquainted with the history of plague can regard the present situation with indifference.

DR. J. MAES contributes to the February number of *Man* an account of certain remarkable fetish images of the Wazimba tribe, which have recently been acquired by the Congo Museum at Terveuren. Those illustrated are rude male and female figures, one of which guards children, a second watches young girls and presides over accouchements, a third guards the house, and a fourth protects people from nightmare. The treatment consists in making the patient, to the accompaniment of magical formulæ, drink an infusion of manioc leaves, which are first laid on the head of the fetish.

IN *Man* for February Mr. M. W. H. Beach describes, largely from hearsay, the strange Punan tribe in Borneo, a people well deserving further study. They are said to wear bark clothing, to have no houses or property, and to wander about the forest and sleep in trees. Intercourse with them is carried on by the methods of silent barter. They have the curious habit of leaping three or four yards at a time instead of walking, and their speed is marvellous. They kill game with the *sumpitan*, or blow-pipe, not by the usual method of blowing into the mouth, but by striking the end which contains the dart with the curved palms of their hands.

THE Journal of the Royal Society of Arts for February 10 contains a report of a lecture, by Capt. A. J. N. Tre-

mearne, on the Kagoro, a naked, head-hunting West African tribe occupying a mountain ridge running from the Bauchi into the Nassarawa province of northern Nigeria. They are notorious head-hunters, and there is a curious analogy between the objects and methods of the practice among them and the Nagas of Assam. Among both races it is a mark of social evolution, a young man showing his fitness for marriage by producing a head. Further than this, it appears, as in the case of the Meriah sacrifice of the Khonds or Kandhs, to be a means of promoting the fertility of the soil, a fowl in Nigeria being now the surrogate of the human victim which was not long since sacrificed by the Indian tribes.

PARTS v. and vi. of the Treasury of Human Inheritance (London: Dulau and Co., Ltd., 1911), issued by the Galton Laboratory for National Eugenics, consists of a monograph on the subject of hæmophilia, by Drs. W. Bullock and Paul Fildes. The authors are to be congratulated on the very thorough manner in which they have performed a task the magnitude of which can be realised when it is stated that the literature list contains full references to and descriptions of 949 separate works. Two hundred and thirty-five pedigrees are diagrammatically represented, and such available clinical notes are provided for each person said to have suffered from the disease as would enable a medical man to form an opinion as to the validity of the diagnosis. Many of these pedigrees deal with a very large number of individuals; thus that of the Tenua families includes eight generations and about 400 persons. Enough has been said to show that a rich mine of material has been opened up, and we hope that it will be worked by the experts in heredity. If they desire fuller information on any point or doubt the accuracy of what is contained in this volume, the excellent bibliography will make reference to the original sources easy for them.

IN an article on natural hair-balls in *The Field* of February 25, Mr. Lydekker records the fact—apparently not referred to in any book on reptiles or general natural history—that the stomachs of South American alligators (caimans) not infrequently contain large balls of hairs, derived, doubtless, from mammals which formed their prey. The evidence rests on the testimony of Mr. J. S. da Costa, who brought home a specimen—now in the Museum of the Royal College of Surgeons—and who states that, in the belief of the natives, such accumulations eventually lead to the death of the reptiles. A hair-ball composed mainly of tenrec-hair, brought to England from Madagascar by Mr. A. Dobrée, may indicate that Old World crocodiles are afflicted in the same manner, although this cannot at present be regarded as certain.

BREEDERS should be much interested in an article, by Mr. R. Bunsow, in the second number of the new serial *The Mendel Journal*, on the inheritance of coat-colour in thoroughbred horses. Taking up the subject from the established fact that bays (including browns) may be either pure as regards the power of transmitting their colour, or impure, when they may give rise to chestnuts, the author states that bays, as being capable of producing offspring of a colour different from their own, are a dominant type (D), while chestnuts, which lack this capacity, are recessive (R). Chestnut horses, as having but one kind of sexual cells, may accordingly all be symbolised as RR, whereas bays may be classed either as DD or DR, according to whether they are pure or whether they contain an admixture of chestnut cells. Now if a DD stallion be mated with an RR mare, all the foals will be DR bays. On the other hand, the foals of an RR mare by a DR stallion will, in the long run, consist of bays and chestnuts in nearly equal numbers. When chestnuts are bred together, their offspring should be all chestnuts (RR), but if chestnuts be crossed with bays, the foals may be either all bays or half chestnuts (RR) and half bays (DR), the former case, as mentioned above, being due to the fact that the parent bays were DD, and the latter to their being DR. Certain exceptions to these conditions occurring in the Stud-book are shown to be due to incorrect registration of colour, and it is probable that the same is the case with the rest. As regards greys, it is asserted that one of the parents must be of this colour.

A SUMMARY, by Mr. A. B. E. Hillas, of reports received relative to the movements of eel-fry during the year ending September 30, 1909, has been received from the Irish Department of Agriculture and Fisheries (Fisheries, Ireland, Sci. Invest., 1910, vi.). This summary, which is a continuation of that of the previous year, presents the substance of replies given to four questions, widely circulated among those likely to be able to give information of the movements of eel-fry in the various river systems. The information at present available is not sufficient to permit the author to state with certainty whether the successive immigrations of fry form parts of one continuous annual series or are divisible into two or more seasonal runs; the facts reported from Wexford seem to support the latter view, whereas in the Coleraine district there was a run from March to June, which was practically continuous from April 21.

A LIST of wild flowers recorded from Barmouth and the neighbourhood is published by Mr. James Kynoch, Brighton. The most interesting part is the list of plants, including cryptogams as well as phanerogams, compiled by the Rev. T. Salwey, and published in 1863, in which localities in the county of Merioneth outside the Barmouth district are given.

PROCEEDING from the appearance of a variant *Œnothera rubricalyx*, distinguished from its progenitor *Œnothera rubrinervis* by increased red coloration in parts of the plant, Dr. R. R. Gates communicates to the *American Naturalist* (April, 1910) an article in which he discusses the bearing of what is regarded as an instance of quantitative colour inheritance, concluding that in many cases the difference between Mendelian hybrids must be simply quantitative, involving a difference either in the amount of certain material substances or in the energy content of certain constituents.

CONTINUING his revisions of fungal species in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxix., part v.), Prof. F. von Höhnel discusses a number of Ascomycetes, and presents a scheme for classifying the Microthyriaceæ. To the same number Miss J. Menz contributes a paper on the morphology of the genus Allium, in which the taxonomic value of the leaf bundles is considered, and a relationship between the Allioideæ and Amaryllidoideæ is suggested, primarily owing to the development of mucilage canals and cells containing raphides.

A FIRST contribution to the flora of Siam, published in the *Kew Bulletin* (No. 1), is jointly provided by Dr. A. F. G. Kerr, who collected the plants and has written an introductory sketch of the vegetation on Doi Sootep, a mountain in northern Siam, and by Mr. W. G. Craib, who is responsible for the identifications. Different types of forest are associated with *Pentacme siamensis*, *Dipterocarpus tuberculatus*, species of Quercus and Castanopsis,

Pinus Khasya, and *Quercus Junghuhnii.* In several of the associations, epiphytes, chiefly orchids and ferns, are a characteristic feature; *Dischidia Rafflesiana, Agapetes Hosseana*, and *Rhododendron Veitchianum* are notable epiphytes. Mr. Craib's list, which is confined to the Polypetalæ, contains a number of species new to science, and a type of a new genus, Pittosporopsis, in the family Icacinaceæ. A very large preponderance of species in the family Leguminosæ is due partly to the number of genera and partly to the variety of species in the genera Desmodium, Crotalaria, Cassia, and Bauhinia.

IN the *Cairo Scientific Journal* for January, Mr. W. Cartwright has an article on the control of the cotton aphis, thus adding one more to the many useful communications relating to cotton cultivation which have appeared in that journal during the past four years, during which but little has been done officially to promote research in this important field.

IN a recent paper (*Bull. de l'Acad. Imp. de Sci. de St. Pétersbourg*, 1911, No. 2) Prince Galitzin discusses the records obtained at Pulkowa of the great earthquake of January 3–4. He finds that the epicentre was situated in lat. 43° 14′ N., long. 78° 24′ E., an estimate which agrees closely with that obtained from the records at Eskdalemuir of lat. 42° N., long. 77° E. Both points lie close to Lake Issyl-kul, and to the epicentral area of the great Vyernyi earthquake of June 9, 1887.

THE seismological bulletins of the observatory at Zikawei for November and December, 1910, consist of registers obtained from Omori and Weichert pendulums. The former weighs about 15 kilos., and the latter about 1200. In December the heavier of these instruments gave twenty-three records, whilst the lighter only gave eighteen. Three out of the twenty-three seem to be peculiar to Zikawei, whilst the remaining twenty were also recorded in Great Britain, and probably at most stations in the world.

A POPULAR article by a resident at Innsbruck, the capital of Tyrol, on the Föhn wind as it strikes an observer, appears in *Symons's Meteorological Magazine* for February. This blows at times with considerable force, sweeping northwards from the Brenner Valley as a warm, dry wind, raising clouds of dust in its track. If it is summer, the atmosphere becomes stiflingly hot, if winter, the keen, frosty air turns mild and close; and it sometimes exerts a depressing influence on the nervous system. From twenty-five years' observations supplied by Dr. H. v. Ficker, Innsbruck has an annual average of forty-three days of Föhn; it is most frequent in spring (seventeen days) and autumn (eleven days). It generally lasts one or two days; twice in the above period it lasted eight days. On vegetation it has its advantages, *e.g.* Innsbruck owes its crops of maize to it, and some floral types from the inter-Glacial period still survive in the Inn Valley. Its attacks are mild compared with those in certain Swiss valleys, where it sometimes uproots trees by its fury.

IN the Australian Monthly Weather Report for March, 1910, Mr. H. A. Hunt gives a very interesting account of a hurricane of exceptional severity that visited the Fiji group of islands on the 24th and 25th of that month. The storm was a remarkable one, and its track can be followed for some 2500 miles from Fiji to New Caledonia, Norfolk Island, and the North Island of New Zealand, where it arrived on the morning of the 30th. The harbour master at Suva states that its approach was quite unexpected; the heat was excessive, but the barometer gave scarcely any warning. At midnight it was falling; at 2h. a.m. it stood at 29·00 in., and the easterly wind was increasing, with heavy rain. At 3h. a.m. it was blowing with hurricane force, and sheets of iron were flying from all directions between E. and N.E.; at 4h. a.m. the barometer had fallen to 28·50 in., and then began to rise. At Levuka there was a calm of about ten minutes as the votex passed over the town, with a complete change of direction, but at Suva the wind simply backed from E. to N.N.E. as the barometer rose. The isobaric charts show that the storm followed the usual track, moving in a W.S.W. direction until caught in the easterly atmospheric drift of mid-latitudes, when it curved to the south-east.

IN the January number of the *American Journal of Science* appears a communication by Dr. L. A. Bauer on gravity determinations at sea, in which he discusses the results obtained by Dr. Hecker in 1901, 1904, and 1909, and indicates the direction in which efforts are being made to attain more satisfactory results during the cruise of *Carnegie*, starting from Cape Town about April, 1911. In spite of the most elaborate precautions which were taken in Hecker's trips, trouble was experienced with the boiling-point thermometers employed to determine the atmospheric pressure in order to compare it with the height of the mercurial column, which, under the same conditions, changes with variations of gravity. Experimental work with boiling-point thermometers was carried out on the *Carnegie* in 1909–10, and the results showed that it would be worth while to attempt gravity work on board of her. The methods and reductions hitherto employed are discussed, and the view is expressed that some error may attach to the results obtained by the boiling-point thermometers, and that in the method of reduction local gravity anomalies observed during a cruise partake of the nature of accidental errors. On the *Carnegie* it is proposed to make both shore and harbour observations, especially at places where pendulum observations have already been made; frequent zero determinations of the thermometers, and comparisons of the barometers with shore standards, wherever available, are to be employed to determine the various errors. The necessary refinement of the barometric work remains as the chief difficulty, and the hope is expressed that, in view of the great importance of the subject, a method superior to the present may be discovered whereby the boiling-point thermometer may be eliminated.

IN an original memoir in the January number of *Le Radium*, M. G. Sagnac, of Paris, shows that in order that the time occupied by two beams of light in describing in opposite directions the contour of an area of considerable magnitude may be the same, it is necessary and sufficient if the vector which defines the relative velocity of the æther with respect to the optical system is irrotational throughout the area enclosed by the contour. In order to test whether the æther in the immediate neighbourhood of the earth possesses this property, M. Sagnac divided a beam of light into two portions, which he sent in opposite directions round a circuit consisting of a horizontal length of about 30 metres, an equal vertical length, and a third sloping one joining the two former. The two beams after traversing the circuit interfere, and the bands are observed in a telescope allowing a determination of displacement of 1/1000 of the width of a band. The plane of the circuit being east and west, observations of the bands were taken at various hours of the day and night, but no displacements were observed equivalent to a change in the relative motion of æther and matter of 1 millimetre per second for an elevation of 1 metre. Any relative

motion that exists must, therefore, be practically irrotational.

THE Journal of the Franklin Institute for February contains a report on recent progress in the chemistry of the terpenes and camphors, by J. S. Hepburn. Similar reports dealing with the sugars and the proteins have appeared in the two preceding years. The present report is based upon Wallach's recently published volume on the "Terpenes and Camphor," and in the space of twenty-five pages gives an excellent summary, which is likely to be of service to those who are unable to make use of the German original.

MR. A. E. PORTER finds that a number of ferments, including pepsin, trypsin, and rennet, are rendered inactive by being kept in contact with artificial membranes, especially with collodion ones. Most ferments which have thus been inactivated have at the same time acquired inhibitive properties. The inactivation of ferments by membranes is not due to simple absorption, for there is no evidence of saturation of the membrane; on the contrary, its inactivating power appears to improve with repeated use. Although the inhibitive power of the inactivated ferments may be due in part to substances preformed in the solution, inhibition is still present after removal of these substances, suggesting that the ferment itself is changed by contact with a membrane into a substance having an inhibiting power on itself (*Quart. Journ. Experiment. Physiol.*, iii., No. 4, December, 1910, p. 375).

THE important discoveries of MM. Paul Sabatier and Senderens on the catalytic action of finely divided metals, notably nickel and copper, have recently been extended to a study of the catalytic action of various metallic oxides. In the current number of the *Comptes rendus* MM. Paul Sabatier and A. Mailhe give an account of a new synthetic method, based on the catalytic effect of titanium oxide, which would appear to possess many practical applications. They show that if a column of titanium dioxide is maintained at a temperature of 280°–300° C., and a mixture of the vapours of a primary alcohol and a fatty acid (other than formic acid) is led over it, the corresponding ester is formed. The same limit is here reached instantaneously as was found by Berthelot after prolonged contact. An excess of either constituent favours the limit of combination of the other. Following this method, the methyl, ethyl, propyl, butyl, isobutyl, and isoamyl esters of acetic, propionic, butyric, isobutyric, isovaleric, and caproic acids have been prepared. Esters of benzyl alcohol have also been readily obtained by this method. The inverse action—the direct hydrolysis of esters by water—is also easily effected, and the use of titanium dioxide reduces any secondary reactions to a negligible amount.

AN article on ferro-concrete beams with single reinforcement appears in *Engineering* for March 3, from the pen of Dr. W. C. Unwin. The object of the article is to put the equations of the ordinary theory into the most convenient form for calculation. The ordinary theory is known to be only roughly approximate, but the assumptions made are believed to be generally on the side of safety. The formulæ, however, are still in some cases very complicated, as given in books, due to the attempt to obtain formal exactness from a mathematical point of view. But the data used in solving problems are themselves only approximate; for instance, the selected value of the coefficient of elasticity of concrete, which itself varies with the stress, and the neglect of the tensile stress in the concrete. Hence it would appear that, for practical purposes, a sacrifice of mathematical exactness in the form of the equations is justifiable, if the errors are small within a practical range. In fact, some of the equations are only used in designing by making assumptions and proceeding by trial and error, or by the use of tables and curves based more or less on experience. Both rectangular and T sections are dealt with in the article, and examples are given of the use in practice of the simplified formulæ deduced.

A COPY has been received of the first number of the *Irish Review*, a monthly magazine of Irish literature, art, and science. Science is represented only by an article on economics by Mr. George W. Moore, in which he deals with the problem of rural life. The magazine is published in Dublin, and may be obtained in London from Messrs. Simpkin, Marshall, Hamilton, Kent and Co. The price is 6*d*. net.

THE annual report for 1910 of the Philosophical Institute of Canterbury, New Zealand, shows that the condition of the institute continues to be satisfactory both as regards the number of members and the active interest displayed in those branches of science which constitute its object. The special lines of research outlined in last year's report have been developed, and some have already given good results. These lines of inquiry are:—observations on the Arthur's Pass tunnel; a survey of the Canterbury lakes; and an examination of the Christchurch artesian system. This is quite apart from the original work which has been carried on by individual members of the institute. A subcommittee has also been considering the question of the more adequate protection of the native fauna. Ten meetings of the institute were held during the year, at which the average attendance was sixty-four. At these meetings twenty-seven papers embodying the results of original research were read. These are classified as follows:—botany, four; zoology, seven; geology, five; chemistry, six; physics, two; mathematics, one; miscellaneous, two.

OUR ASTRONOMICAL COLUMN.

THE BRILLIANT METEOR OF FEBRUARY 19.—Mr. W. F. Denning writes:—"A very good observation of this object comes from Mr. Felix de Roy, of Antwerp, who describes the apparent path as from 27°+34° to 11°+60°, and onwards to the north-east. He gives the duration as twelve seconds, but this only relates to a portion of the flight. To him the meteor disappeared in a cloud.

"At Putney the object was seen by Mr. F. E. Baxandall, who gives the duration as fifteen seconds, but I do not know whether the newspaper account of his observations includes the course of the meteor. The radiant point appears to have been at 46°−15° in Eridanus, and the heights 70 to 49 miles along a path 590 miles long, and probably this does not include the whole extent of the visible luminous trajectory. Its motion seems to have passed from over the English Channel between Brest and Plymouth to Oldenburg, in Hanover. From Stowmarket the meteor was seen to rise from the south-west horizon, and at Antwerp it was low in the north-east when it disappeared. The meteor may therefore have sailed along in a nearly horizontal flight much further, but it was rising, not falling, to the earth when last seen.

"This meteor, though of such an extended course, is not beyond precedent, for according to the computations of the late Prof. Herschel the fireball of August 18, 1783, had a path of 1000 to 1200 miles; that of September 5, 1868, was watched along 880 miles; while that of July 20, 1860, was traced more than 1000 miles. It will be important to secure observations of the meteor of February 19 from Cornwall or the north-west coast of France, and from Holland and Hanover or that region."

HALLEY'S COMET.—Dr. Ebell publishes a bi-daily ephemeris for Halley's comet, extending to April 30, in No. 4476 of the *Astronomische Nachrichten*. Although the comet is not likely to be observed with ordinary instru-

ments, it is interesting to note that its present position is 10h. 30·2m., $-13°$ 48·2′, roughly about one-third of the distance from υ towards λ Hydræ; it is travelling north and west, towards Sextans, and its distance from the earth is about 330 million miles. Prof. Barnard's observation, of January 8, gives a correction to Dr. Ebell's ephemeris of $+12$s., $-0·5′$, and the ephemeris shows that by April 30 the comet should be about one magnitude fainter than when Prof. Barnard saw it.

The Angular Speed of Rotation of a Long-enduring Prominence.—From the study of the Kodaikánal spectroheliograms of a prominence which endured, in more or less the same form, for eighty-two days, Mr. Evershed arrives at some important conclusions, which he publishes in No. 1, vol. xxxiii., of the *Astrophysical Journal*. When first photographed, the prominence was on the western limb, was 55″ high, and covered from $+2°$ to $-14°$ in latitude. Its seventh, and last, "limb" appearance was on April 28, when it was 80″ high, and extended over latitudes $-7°$ to $-23°$; on each occasion, after the first, it was seen for three successive days on the limb. Not only was this object photographed on the limb, it is also seen as an absorption marking on a number of "disc" photographs taken, and is shown as such on the four magnificent photographs reproduced.

Measures of the photographs show that the dark mass of calcium (and hydrogen) vapour near the equator had, during February, a speed 5 per cent. greater than the general surface of the photosphere, and, during the March apparition, a speed 11 per cent. greater. They also indicate that the two apparitions really represent two distinct masses of gas emanating from a common origin in solar longitude 75°. The general aspect and behaviour of the prominence suggest that it was continuously renewed by glowing gas emanating from numerous photospheric orifices.

The enormous activity attending such phenomena is indicated by the fact that, on March 25, the prominence extended over at least 36° of latitude, or was 250,000 miles long, yet twenty-four hours later the whole object had completely vanished.

Radial-velocity measures made when the prominence was on the limb, on March 17 and 18, showed that the prominence, at a considerable height, was moving at a speed 34 per cent. greater than the normal chromosphere, and they suggest that the acceleration of velocity with height, discovered by Adams, may be continued beyond the limits of the chromosphere. The measures were made, with a radial slit set across the limb at the equator, on the Hα line, and the difference measured was that between the absorption line, representing the normal chromospheric line, and the bright prominence line.

Conjunctions of Major Planets and Stars in 1911.—According to Prof. Banachiewicz, in No. 4465 of the *Astronomische Nachrichten*, there will be three near conjunctions with Mars and one occultation by Jupiter this year.

On May 3, at 11h. (G.M.T.), Mars will be in conjunction with and 18″ S. of B.D. $-10°$ 5892, a star of magnitude 7·5; on May 10, at 12·6h., the planet will pass 0·8′ S. of the sixth-magnitude, fundamental star h Aquarii, and on August 9, at 11·7h., it will pass within 15·5″ of the star AG. Lpz. I. 898 (mag. 8·5); it is possible that the unknown proper motion of the star may make this an occultation.

The star B.D. $-12°$ 4042 (mag. 6·5) will be occulted by Jupiter on August 13 at 0·2h. G.M.T., and the phenomenon will be observable in Australia and eastern Asia.

Astrophysics in the United States.—The *Revue générale des Sciences* for February 15 (No. 3) contains a very interesting illustrated article, by M. Bosler, in which the author summarises the recent progress of astrophysical methods in the United States. M. Bosler includes the methods employed at Harvard in the systematic study of the stars and their spectral classification, the radial-velocity and other researches at Mount Hamilton, the multifarious observations made at the Yerkes Observatory, and the great progress in methods, instruments, and knowledge which has taken place at Mount Wilson since the solar observatory was founded on its elevated site. The article is freely illustrated with photographs, and gives an excellent idea of the great advances made in our knowledge of the universe under the favourable financial and climatic conditions which obtain in the States.

Studies of Algol Variables.—The Journal of the College of Science, Imperial University of Tokio, for January 18, contains a paper, in English, by Mr. Naozo Ichinohe, in which the author discusses a large number of variable stars of the algol type. After giving a brief historical account, Mr. Ichinohe defines an algol variable, and then gives a list of ninety-three stars which conform to his definitions. He then discusses the periods, densities, distribution, magnitudes, spectra, &c., and, with a number of tables, makes up a useful epitome of our knowledge concerning this type of star.

The Spectroscopic Binary u Herculis.—In 1848, the star u Herculis was suspected by Schmidt to vary; but its light-changes were puzzling, and it was not until 1869 that he concluded it to be a variable, with a period of about forty days, which at minimum suffered rapid changes. Frost and Adams, in 1903, showed the star to be a spectroscopic binary.

In No. 9, vol. ii., of the Publications of the Allegheny observatory, Dr. Baker discusses the radial velocities of this star, determined from spectrograms taken with the Mellon spectrograph, and finds it to be an eclipsing variable of the β Lyræ type, with a period of 2·051 days, and a secondary minimum about a day later. The presence of this secondary minimum, and the presence of the fainter spectrum on the plates, afford a unique opportunity of ascertaining the relative densities of the two stars and other data bearing on the question of double-star evolution. Dr. Baker finds that the diameter of either star is nearly six times that of the sun; that the brighter star (visual mag. = 5·0) is 7·5 as massive, but only one twenty-seventh as dense as the sun, while the fainter star (mag. 6·0) is 2·9 times as massive and one-seventieth as dense; that the centre of gravity of the system lies well within the surface of the brighter star, its mean distance from the centre of each body being 2,900,000 and 7,300,000 km., respectively, and that the surface brightness of the massive star is 2·5 times that of the other, although the spectra are practically identical. If the parallax were accurately known, it would be possible to determine, for this case, whether helium stars, such as these two are, or solar stars, have the greater surface brightness; assuming the parallax to be 0·02″ or greater, it would appear that the surface brightness of the fainter star, at least, is less than that of our sun.

FORTHCOMING BOOKS OF SCIENCE.

Agriculture.

A. and C. Black.—Wheat-growing in Canada, the United States, and the Argentine, W. P. Rutter, illustrated. *T. Werner Laurie.*—The Training of the Farmer, Dr. L. H. Bailey. *John Murray.*—Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with special reference to British West Africa, issued under the authority of the Secretary of State for the Colonies, and edited by Dr. W. R. Dunstan, F.R.S.:—The Agricultural and Forest Products of British West Africa, G. C. Dudgeon, illustrated. *Swan Sonnenschein and Co., Ltd.*—Prosperous Agriculture: or Food Land the Raw Material, F. W. Wateridge, illustrated.

Anthropology.

Macmillan and Co., Ltd.—The Golden Bough: a Study in Magic and Religion, Dr. J. G. Frazer, third edition, in 6 parts, Part i., The Magic Art and the Evolution of Kings, 2 vols.; The Baganda, a General Survey of their Country, Life, and Customs, Rev. J. Roscoe, illustrated; The Nāga Tribes of Manipur, T. C. Hodson, illustrated. *John Murray.*—The Castes and Tribes of Eastern India, Sir H. Risley, K.C.I.E., C.S.I., illustrated. *The Oxford University Press.*—The Suk: their Language and Folklore, M. W. H. Beech, with introduction by Sir C. Eliot. *Swan Sonnenschein and Co., Ltd.*—Bushman Folk Lore, Miss L. C. Lloyd, with a preface by Dr. G. McCall Theal, illustrated.

Biology.

Edward Arnold.—Practical Photo-micrography, J. E. Barnard, illustrated. *Baillière, Tindall and Cox.*—Micro-organisms, M. Herzog. *A. and C. Black.*—The Open Book of Nature, a Book of Nature-study for Young People, Rev. C. A. Hall, illustrated; The Life and Love of the Insect, J. H. Fabre, translated by A. Teixeira de Mattos, illustrated. *W. Blackwood and Sons.*—The Elements of British Forestry: a Handbook for Forest Apprentices, J. Nisbet. *The Cambridge University Press.*—An English Flora, Dr. C. E. Moss, assisted by specialists, 10 vols. probably, illustrated. *Cassell and Co., Ltd.*—The Nature-lover's Handbook; Breeding and the Mendelian Discovery, A. D. Darbishire, illustrated. *J. M. Dent and Sons, Ltd.*—Physiology Primer, Prof. C. S. Sherrington, F.R.S.; Zoology Primer, Prof. W. A. Herdman, F.R.S. *Duckworth and Co.*—Cacao: its Culture and Preparation, J. H. Hart. *Gurney and Jackson.*—A History of British Mammals, G. E. H. Barrett-Hamilton, continuation in parts, illustrated; Rhopalocera Exotica, being Illustrations of New, Rare, or Unfigured Species of Butterflies, H. Grose-Smith and W. F. Kirby, 3 vols., illustrated, reduced in price. *Henry Holt and Co. (New York).*—The Animals and Man, Prof. V. L. Kellogg, illustrated; Plant Life and Evolution, Prof. D. H. Campbell; a revised edition of Hertwig's Manual of Zoology, Prof. J. S. Kingsley; A Key to High School Botany, Prof. Atkinson. *T. C. and E. C. Jack.*—The British Bird Book, edited by F. B. Kirkman, illustrated, further sections; Present-day Gardening, edited by R. H. Pearson, illustrated; Rhododendrons and Azaleas, W. Watson; Carnations and Pinks, T. H. Cook, J. Douglas, and J. F. M'Leod; Roses, H. E. Molyneaux. *A. Melrose.*—The Biology of the Seasons, Prof. J. A. Thomson, illustrated. *The Methodist Publishing House.*—Butterflies, and How to Identify Them, S. N. Sedgwick. *Methuen and Co., Ltd.*—Studies of Trees and Flowers, M. Wrigley, illustrated; The Freshwater Fishes of the British Isles, C. T. Regan, illustrated; The Life of Crustacea, Dr. W. T. Calman, illustrated; Our Insect Friends and Foes, F. M. Duncan, illustrated; The Young Ornithologist: a Guide to the Haunts, Homes, and Habits of British Birds, W. P. Westell, illustrated; Preliminary Hygiene, W. Narramore, illustrated; Elementary Lessons on Plant Life, Miss D. G. Scott, illustrated. *Mills and Boon, Ltd.*—The Bee-keeper's Companion, S. S. Abbott, illustrated. *Milner and Co.*—Prehistoric Man, J. McCabe. *John Murray.*—Ornamental Bulbous and Tuberous Plants for the Open Air, Greenhouse, and Hothouse, with details as to Descriptions, Culture, and Propagation, J. Weathers, illustrated; The Genus Rosa, E. Willmott, drawings by A. Parsons, in parts, continued; Criminal Man—According to Lombroso, G. Lombroso Ferrero, and The Cell and Cellular Reproduction of Living Beings, Dr. Marcus Hartog (Progressive Science Series). *The Oxford University Press.*—Forest Terminology, J. Gerschel and W. R. Fisher, a new edition of the work published in France, and now printed in French, German, and English. *Kegan Paul and Co., Ltd.*—A History of Birds, Dr. H. O. Forbes. *Sir I. Pitman and Sons, Ltd.*—British Ferns: a Pocket Help for the Student and Collector, comprising all the Native Species and showing Where Found, F. G. Heath, illustrated. *G. Putnam's Sons.*—Neglected Factors in Evolution, H. M. Bernard. *Lovell Reeve and Co., Ltd.*—The Coleoptera of the British Islands, Rev. W. W. Fowler and H. Donisthorpe, supplementary volume; British Diptera, P. H. Grimshaw, in parts; The Flora of Tropical Africa, Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S. (continuation); Lepidoptera Indica, Col. S. Swinhoe (continuation). *Alston Rivers, Ltd.*—British Plants: their Biology and Ecology, J. F. Bevis, illustrated. *G. Routledge and Sons, Ltd.*—Alpine Plants of Europe, with Cultural Hints, H. S. Thompson, illustrated. *Smith, Elder and Co.*—Thoughts on Trout Fishing, H. Russell; Grouse Disease Enquiry. Under the direction of the Committee on Grouse Disease the general questions have been treated by A. S. Leslie, Dr. E. A. Wilson, and the scientific by Dr. A. E. Shipley, F.R.S.; subscription edition, in 2 vols., illustrated. *Swan Sonnenschein and Co., Ltd.*—Elementary Text-book of Practical Botany, for the Botanical Laboratory and Private Student, Prof. E. Strasburger, edited by Prof. W. Hillhouse, illustrated, new edition; Plant Life: a Manual of Botany for Schools, Prof. E. Warming, translated by E. Rehling and E. M. Thomas, illustrated. *John Wiley and Sons (New York).*—Forest Physiography, I. Bowman; Principles of Handling Woodlands, H. S. Graves. *Witherby and Co.*—Photography for Bird-lovers, B. Beetham, illustrated; The Birds of Australia, G. M. Mathews, illustrated, part ii.; A Fisherman's Summer in Canada, F. G. Aflalo.

Chemistry.

Edward Arnold.—The Chemistry and Testing of Cement, Dr. C. H. Desch. *A. and C. Black.*—Chemical Analysis, Qualitative and Quantitative, a Text-book for Technical Schools and Colleges, G. G. Gardiner, vol. i. *Gauthier-Villars (Paris).*—Notions fondamentales d'Analyse qualitative, Thomas and Gauthier; Analyses chimiques métallurgiques, J. Hognon. *Gurney and Jackson.*—Technical Methods of Chemical Analysis, edited by Dr. G. Lunge, translated, adapted, and edited by Dr. C. A. Keane, vol. ii. in two parts, and vol. iii.; The Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches, a Theoretical and Practical Treatise, Dr. G. Lunge, vol. iii., Ammonia-soda, Processes of Alkali Making and the Chlorine Industry, new edition. *Henry Holt and Co. (New York).*—A revised edition of Noyes' Qualitative Analysis. *Longmans and Co.*—New Ideas on Inorganic Chemistry, Prof. A. Werner, translated, with the author's sanction, from the second German edition, by Dr. E. P. Hedley; The Chemistry of Synthetic Drugs and the Application of Chemistry to Pharmacology, P. May; Monographs on Biochemistry, edited by Drs. R. A. Plimmer and F. G. Hopkins:—Oxidation and Reduction, Dr. H. D. Dakin. *Sampson Low and Co., Ltd.*—Triumphs and Wonders of Modern Chemistry, Dr. G. Martin, illustrated. *Macmillan and Co., Ltd.*—Crystallography and Practical Crystal Measurement, Dr. A. E. H. Tutton, F.R.S., illustrated. *Methuen and Co., Ltd.*—Higher Mathematics for Chemical Students, J. R. Partington; Elementary Chemical Theory, J. M. Wadmore; A Practical Chemistry for Technical Institutes, Dr. A. E. Dunstan; Outlines of Physical Chemistry, Dr. G. Senter, new edition. *Kegan Paul and Co., Ltd.*—Crystals, Dr. A. E. H. Tutton, F.R.S., illustrated. *Swan Sonnenschein and Co., Ltd.*—Introduction to the Study of Organic Chemistry, J. Wade, illustrated; a re-issue of the revised edition. *John Wiley and Sons (New York).*—A Laboratory Manual of Inorganic Chemistry, E. C. Bingham and G. T. White; Introduction to Chemistry, Prof. W. Ostwald, translated by W. T. Hall and R. S. Williams, illustrated.

Engineering.

Constable and Co., Ltd.—The Encyclopædia of Municipal and Sanitary Engineering, edited by W. H. Maxwell and J. T. Brown, illustrated. *Gauthier-Villars (Paris).*—Recherche pratique et exploitation des mines d'or, G. Proust; Calcul et construction des Alternateurs mono- et polyphasés, H. Birven (traduit de l'allemand par P. Dufour); Formation et carrière de l'ingénieur-électricien, A. Blondel; Organisation des Usines, Ballewski (traduit de l'allemand par A. Mayer). *T. Werner Laurie.*—The Aëroplane—Past, Present, and Future, C. Graham White and H. Harper, illustrated. *Crosby Lockwood and Son.*—Engineer's Year Book for 1911, comprising Formulæ, Rules, Tables, Data, and Memoranda, forming a compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas and Mine Engineering, H. R. Kempe, with a collaboration of eminent specialists, illustrated; Marine Steam Turbines, a Handbook for the use of Students, Engineers, and Naval Constructors, based on the work "Schiffsturbinen," Dr. G. Bauer and O. Lasche, translated from the German by M. G. S. Swallow, illustrated. *Longmans and Co.*—The Testing of Motive-power Engines, including Steam Engines and Turbines, Locomotives, Boilers, Condensers, Internal Combustion Engines, Gas Producers, Refrigerators, Air Compressors, Fans, Pumps, &c., R. Royds, illustrated. *E. and F. N. Spon, Ltd.*—The Theory and Practice of Model Aëroplaning,

V. E. Johnson, illustrated; The Corliss Engine, J. T. Henthorn and C. D. Thurber, illustrated; Handbook of Cost Data, H. P. Gillette, for contractors and engineers, illustrated; Well-boring for Water, Brine, and Oil, C. Isler, new edition, revised and enlarged; illustrated; Milling Machines and Milling Practice, a Practical Manual for the Use of Manufacturers, Engineering Students, and Practical Men, D. De Vries, illustrated. *Whittaker and Co.*—Elementary Aëronautics, or the Science and Practice of Aërial Machines, A. P. Thurston; The Practical Design of Reinforced Concrete Beams and Columns, W. N. Twelvetrees; Ventilation of Electrical Machinery, W. H. F. Murdoch; Design of Alternating Current Machinery, J. R. Barr. *John Wiley and Sons (New York).*—Railway Station Service, B. C. Burt; Rock Drilling, R. T. Dana and W. L. Saunders; Pumping Machinery, A. M. Greene, jun.; Notes on Plate Girder Design, C. W. Hudson. *Williams and Norgate.*—How to Build an Aëroplane, R. Petit, translated by T. O. B. Hubbard and J. H. Ledeboer, illustrated, new edition.

GEOGRAPHY AND TRAVEL.

A. and C. Black.—Geographical Pictures: Land Forms and how They are Made. In packets of six cards. (1) Structure of the Earth's Crust; (2) Elevation and Depression of the Land; (3) The Sculpture of the Surface; (4) Rivers, (6) The Ocean, (7) Volcanoes and Volcanic Activity (Sculpturing Agents); (9) Plateaus and Plains (Positive Land Forms); (12) Deserts, (13) Steppes, (14) Forests (Land Forms with Typical Vegetation); Geographical Diagrams and Land-forms Series, H. J. Snape, North America and Eurasia, South America, Africa, and Australasia. *Constable and Co., Ltd.*—Adventure, Sport and Travel on the Tibetan Steppes: an Account of the Travels of C. H. Mears and J. A. Brooke, W. N. Fergusson, illustrated. *Gauthier-Villars (Paris).*—Manuel de l'Explorateur, Blim and R. de L'Isle, new edition. *Henry Holt and Co. (New York).*—Influences of Geographical Environment, E. C. Semple. *Macmillan and Co., Ltd.*—Man and Beast in Eastern Ethiopia, J. Bland-Sutton, illustrated; Sport in the Nilgiris, F. W. F. Fletcher, illustrated. *The Oxford University Press.*—Historical Geography of the British Colonies, Sir C. P. Lucas, vol. v., part iii., Canada (Geographical), part iv., Newfoundland, both parts by J. D. Rogers; Australia: Physiographic and Economic Aspects, T. G. Taylor. *G. Philip and Son, Ltd.*—All the World in Picture and Story: a First Book of Geography, J. Riley; Practical Exercises in Geography: British Isles, with maps, C. R. Dudley; Elementary Practical Geography, E. Young; Series 2 of L'Estrange's Geographical Pictures: British Isles, Historical, Industries, Famous Scenery and Cities, with Notes, &c., P. H. L'Estrange. *Swan Sonnenschein and Co., Ltd.*—The Danube with Pen and Pencil, Capt. R. G. Baker, illustrated.

GEOLOGY.

Constable and Co., Ltd.—The Stone Age in North America, W. K. Moorhead, 2 vols., illustrated. *Dulau and Co., Ltd.*—The Zones of the Chalk in Hants, C. Griffiths and R. M. Brydone, with appendices by the authors of Bourgueticrinus and Echinocorys, and by Dr. F. L. Kitchin on a new species of Thecidea, illustrated. *Macmillan and Co., Ltd.*—Geology and Geography of Northern Nigeria, Dr. J. D. Falconer, illustrated. *Milner and Co.*—Geology: Chapters of Earth History, G. Hickling. *John Murray.*—Student's Elements of Geology, Sir Charles Lyell, revised by Prof. J. W. Judd, C.B., F.R.S., new edition, illustrated. *E. and F. N. Spon, Ltd.*—Tables for the Determination of Common Rocks, O. Bowles. *Whittaker and Co.*—Mineralogy: the Characters of Minerals, their Classification and Description, Dr. F. H. Hatch, new and enlarged edition.

MATHEMATICAL AND PHYSICAL SCIENCE.

A. and C. Black.—Practical Physics, a Text-book for Technical Schools and Colleges, A. McLean, vol. i.; Climatic Control, L. C. W. Bonacina, illustrated. *Cassell and Co., Ltd.*—Practical Electricity, the late Prof. Ayrton, F.R.S., and Prof. T. Mather, F.R.S.; Astronomy for All, B. H. Bürgel, translated by S. Bloch, illustrated. *John Murray.*—A School Calculus, A. M. and J. D. McNeile. *Gauthier-Villars (Paris).*—Les principes de l'Analyse, R. d'Adhemar; Essai de Géométrie analytique modulaire, G. Arnoux; Précis d'Optique, P. Drude, publié d'après l'ouvrage allemand, refondu et complété par Marcel Boll, 2 vols.; Traité d'Energétique, P. Duhem, 2 vols.; Cours d'Analyse mathématique, E. Goursat, tome ii., 2e édition; Œuvres, Ch. Hermite, tome iii.; Théorie des fonctions métasphériques, Prof. N. Nielsen; Œuvres, W. Ritz; Précis de Télégraphie sans fil, Zenneck, traduit de l'allemand par MM. Blanchin, Guérard et Picot; Leçons sur le prolongement analytique, Zoretti. *Harper and Brothers.*—The Birth of Worlds and Systems, Prof. Bickerton. *Longmans and Co.*—Tables of Physical and Chemical Constants and some Mathematical Functions, Dr. G. W. C. Kaye and Prof. T. H. Laby. *Macmillan and Co., Ltd.*—Elementary Dynamics, Prof. A. Gray, F.R.S.; A School Algebra, H. S. Hall, part ii.; A New Algebra, S. Barnard and J. M. Child, part v. *Methuen and Co., Ltd.*—Practical Physics: a Laboratory Course for Advanced Students, S. S. Richardson, illustrated. *John Murray.*—The Tides and Kindred Phenomena of the Solar System, Sir G. H. Darwin, K.C.B., F.R.S., illustrated. *Kegan Paul and Co., Ltd.*—Light and Photography, Dr. H. Vogel and A. E. Garrett, revised and brought up to date by A. E. Garrett, illustrated. *E. and F. N. Spon, Ltd.*—Simple Treatise on the Planimeter and Land Area Tables, W. Codd; Barlow's Tables of Squares, Cubes, Square Roots, Cube Roots, Reciprocals of all Integer Numbers up to 10,000. *John Wiley and Sons (New York).*—Descriptive Geometry, J. C. Tracy and H. B. North.

MEDICAL SCIENCE.

Edward Arnold.—A Pocket-book of Treatment, Dr. R. W. Leftwich. *Baillière, Tindall and Cox.*—Atlas of First Aid, B. Myers; Military Sanitation, E. B. Knox. *A. and C. Black.*—Text-book of Operative Surgery, Dr. Th. Kocher, third English edition, translated from the fifth German edition by H. J. Stiles, illustrated. *Cassell and Co., Ltd.*—A System of Surgery, edited by Dr. C. C. Choyce and Dr. J. M. Beattie, vol. i., dealing with General Surgery and Surgical Pathology, Surgical Bacteriology, Shock, X-Rays, Anæsthetics, Specific Infective Diseases, &c., illustrated. *J. and A. Churchill.*—A System of Treatment, by British Authors, in four volumes, edited by Drs. A. Latham and T. C. English, vols. i. and ii., General Medicine and Surgery, vol. iii., Special Subjects, vol. iv., Gynæcology and Obstetrics; A Text-book of Diseases of the Skin, Dr. J. H. Sequeira, illustrated; Materia Medica, Step by Step, A. W. Nunn; The Refraction of the Eye, G. Hartridge, new edition, illustrated. *Constable and Co., Ltd.*—The Economy of Food: a Popular Treatise on Nutrition, Food and Diet, by J. Alan Murray. *Henry Frowde and Hodder and Stoughton.*—"606" and other Recent Advances in the Treatment of Syphilis, Prof. Ehrlich and J. R. McDonagh. *Macmillan and Co., Ltd.*—A System of Medicine, by Many Writers, second edition, edited by Sir Clifford Allbutt, K.C.B., F.R.S., and Dr. H. D. Rolleston, vol. ix. (concluding the work), Diseases of the Skin; Deformities: a Treatise on Orthopædic Surgery, intended for Practitioners and Advanced Students, A. H. Tubby, new edition, 2 vols., illustrated; Disease in Bones and its Detection by the X-Rays, E. W. H. Shenton, illustrated; Diseases of the Ear, Drs. W. Milligan and W. Wingrave, illustrated; An Introduction to Therapeutic Inoculation, D. W. Carmalt-Jones; Text-book of Human Physiology, Dr. L. Luciani, translated by F. A. Welby, and edited by Dr. M. Camis, with a preface by Prof. J. N. Langley, F.R.S., illustrated, in 4 vols., vol. i., Circulation. *Methuen and Co., Ltd.*—Unsoundness of Mind, Dr. T. S. Clouston, illustrated; Methuen's Health Readers, vol. i., C. J. Thomas. *Milner and Co.*—Medical Science, Dr. S. Hillier. *John Murray.*—Yellow Fever and its Prevention: a Manual for Medical Students and Practitioners, Sir R. W. Boyce, F.R.S., illustrated. *G. Putnam's Sons.*—The History of Medicine, Philosophical and Critical: from its Origin to the Twentieth Century, D. A. Gorton, 2 vols., illustrated. *Reb-*

man, Ltd.—The Abdomen Proper, Dr. W. C. Morton, illustrated; The Treatment of Syphilis with Dioxy-diamido-arseno-benzol ("Ehrlich-Hata 606"), Dr. W. Wechselmann, with an introduction by Dr. P. Ehrlich, illustrated. *Wm. Rider and Son, Ltd.*—Abnormal Psychology, Dr. I. H. Coriat.

TECHNOLOGY.

Cassell and Co., Ltd.—Hardening and Tempering Steel, a Workshop Guide to the Heat Treatment of all Steels, including High-speed, edited by B. E. Jones, illustrated; Electric Primary Batteries, edited by B. E. Jones, illustrated; Electric Accumulators, edited by B. E. Jones, illustrated; Cyclopædia of Photography, edited by B. E. Jones, in parts, illustrated. *J. and A. Churchill.*—The Principles of Aëroplane Construction, with Calculations and Formulæ, R. Kennedy, illustrated. *Constable and Co., Ltd.*—The Static Transformer, H. M. Hobart, illustrated; Handbook of Testing, C. A. Smith, part i., Materials, part ii., Prime Movers; Applied Thermodynamics for Engineers, W. D. Ennis, illustrated; Electric Furnaces and their Industrial Applications, J. Wright, new edition, illustrated; Arc Lamps and Accessory Apparatus, J. H. Johnson; Motors, Secondary Batteries, &c., S. K. Broadfoot; Electrical Mining Installations, P. W. Freudemacher; Building in London, H. Cubitt; Gas Engines, Capt. H. Riall Sankey, W. J. Marshall, illustrated; Wood Pulp, Charles F. Cross, E. J. Bevan, and R. W. Sindall, illustrated. *Gauthier-Villars (Paris).*—Systèmes cinématiques, *Crosby Lockwood and Son.*—Three-phase Transmission, a Practical Treatise on the Economic Conditions governing the Transmission of Electric Energy by Underground and Overhead Conductors, W. Brew, illustrated; Aërial or Wire Rope-ways, their Construction and Management, A. J. Wallis-Tayler, illustrated; The Modern Motor Car and its Mechanism, a Practical Handbook on the Management and Maintenance of the Car, for the use of Owners and Drivers, W. G. Duncan, illustrated; Short Specifications of Materials, Labour, and Goods, for Works connected with Building, J. Cubitt; Crushing and Grinding Machinery Practice, a Handbook on the Machinery used in Crushing and Grinding Operations on all classes of materials, T. G. Marlow, illustrated; Drying Processes and Patents, T. G. Marlow, describing the various Drying Processes as applied to Sundry Materials, also a Classified Summary of the Patents connected with Drying Processes and Apparatus; A Handbook on the Gas Engine, a Practical Treatise on the Design, Construction, and Running of Internal Combustion Engines, H. Haeder, translated from the German, with the addition of numerous useful tables and other matter by W. M. Huskisson, illustrated; Sewerage Systems, their Design and Construction, a Practical Treatise upon the principles of the Design, Construction and Maintenance of Town Sewerage Systems, with examples of existing works, H. S. Watson, with Legal Notes by E. B. Herbert, illustrated; Reinforced Concrete Design Simplified, Diagrams, Tables, and other data for designing and checking accurately and speedily, J. C. Gammon, with an introduction by H. K. Dyson; Technical Terms, English-German, German-English: a Pocket Glossary, suitable for the Engineering, Manufacturing, and Mining Industries, J. G. Horner, in collaboration with A. Schlomann. *Longmans and Co.*—A Practical Guide to Iron and Steel Analysis, for Students and others, W. Macfarlane; The Principles of Electro-deposition: a Laboratory Guide to Electro-plating, S. Field, illustrated. *Methuen and Co., Ltd.*—Rubber, Dr. P. Schidrowitz, illustrated. *Scott, Greenwood and Son.*—Spirit Varnishes and Spirit Varnish Materials, J. G. McIntosh, being vol. iii. of The Manufacture of Varnishes, illustrated; Casein: its Preparation and Technical Utilisation, translated from the German of R. Scherer, new English edition, revised and enlarged, illustrated; Lubricating Oils, Fats and Greases, their Origin, Preparation, Properties, Uses, and Analysis, a Handbook for Oil Manufacturers, Refiners and Merchants, and the Oil and Fat Industry in General, G. H. Hurst, illustrated, new edition; Edible Fats and Oils, their Composition, Manufacture, and Analysis, W. H. Simmons and C. A. Mitchell; Chemical Manures, translated from the French of J. Fritsch, illustrated; Chemical Works, their Design, Erection, and Equipment, S. S. Dyson and S. S. Clarkson, illustrated; Foods and Drugs, E. J. Parry and C. H. Bennett, vol. i., Chemistry and Analysis of Foods and Drugs, vol. ii., Law Relating to Foods and Drugs; Yarn and Warp Sizing in all its Branches, C. Kretschmar, translated from the German by C. Salter, illustrated; Dressings and Finishings for Textile Fabrics and their Application, Description of all the Materials used in Dressing Textiles: their Special Properties, the Preparation of Dressings and their Employment in Finishing Linen, Cotton, Woollen, and Silk Fabrics, Fireproof and Waterproof Dressings, together with the principal Machinery Employed, F. Polleyn, translated from the third German edition by C. Salter, illustrated. *E. and F. N. Spon, Ltd.*—Workshop Receipts, vol. iv., Rainwater Separators to Wire Ropes, new edition, illustrated. *Whittaker and Co.*—Electric Wiring Diagrams, W. P. Maycock; Colour in Woven Design, Prof. R. Beaumont, new and revised edition. *John Wiley and Sons (New York).*—How to Enamel, being a Treatise on the Practical Enamelling of Jewellery with Hard Enamel, illustrated; Metallurgy, a Brief Outline of the Modern Processes for Extracting the More Important Metals, W. Borchers, translated by W. T. Hall and C. R. Hayward; High-efficiency Electrical Illuminants and Illumination, R. W. Hutchinson, jun., illustrated; The Analysis of Non-ferrous Alloys, W. B. Price and R. K. Meade.

MISCELLANEOUS.

A. and C. Black.—A new edition of The Grammar of Science, Prof. Karl Pearson, F.R.S. *Dulau and Co., Ltd.*—A Monograph on Albinism in Man, Prof. Karl Pearson, F.R.S., E. Nettleship, and C. H. Usher, parts ii. and iii., illustrated. *Macmillan and Co., Ltd.*—The Psychology of Education, Prof. J. Welton; Ancient Hunters and their Modern Representatives, Prof. W. J. Sollas, F.R.S., illustrated. *Methuen and Co., Ltd.*—Body and Mind: a History and Defence of Animism, W. McDougall, illustrated. *John Murray.*—The Excavation of Gezer, 1902–5 and 1907–9, Prof. R. A. S. Macalister, illustrated. *The Oxford University Press.*—Excavations in Nubia, 1909–10, Prof. J. Garstang, F. Ll. Griffith, and Prof. A. H. Sayce. *Kegan Paul and Co., Ltd.*—Practical Archæology, Prof. Garstang; The Modern Science of Language, H. C. Wyld. *Rebman, Ltd.*—The Mechanism of Life, being the only authorised translation of Prof. S. Leduc's "Théorie Physico-Chimique de la Vie et Générations Spontanées," by Dr. D. Butcher; The Individual and Society: or, Psychology and Sociology, Prof. J. M. Baldwin. *Swan Sonnenschein and Co., Ltd.*—Physiological Psychology, Prof. W. Wundt, a translation of the fifth and wholly rewritten German edition by Prof. E. B. Titchener, in 3 vols., vol. ii., illustrated; The Adolescent, J. W. Slaughter; Scientific Romances, the late C. H. Hinton, reissues of "The Persian King," "Casting out Self," "A Plane World."

CANADIAN MINERAL STATISTICS.[1]

THE report before us contains a number of short articles on various points of special interest to those engaged in mining operations in Canada, and should prove of decided value to them, though it must be admitted that in the majority of cases the interest is mainly local. A short note refers to accidents in Canadian mines caused by explosives, and shows that the high accident death-rate is due to the absence of protective legislation in Canada. The following is given as the death-rate per 1000 miners in various parts of Canada:—

	per 1000
British Columbia, Coal Mines, 1899–1908 ...	9·21
Nova Scotia, Coal Mines, 1899–1908	2·67
British Columbia, Metal Mines, 1908	5·93
Ontario, Copper and Nickel Mines, 1907 ...	2·19
Ontario, Silver and Iron Mines, 1907	7·36

These figures afford convincing evidence of the need of a complete mining code, properly administered, seeing that there is nothing in the mining conditions of Canada to which so formidable a death-rate can fairly be ascribed.

[1] Canada, Department of Mines. Summary Report of the Mines Branch for the Calendar Year ending December 31, 1909. Pp. 31. No. 26*a*. (Ottawa, 1910.) Price 10 cents.

A summary of the mineral production of Canada for 1909 is given, some of the more interesting items of which are as follows:—

Metallic.

Copper	... ...	54,061,106 lbs.
Gold	... ... about	£2,000,000 sterling
Pig iron from Canadian ore	...	149,444 tons
Iron ore exports ...	... ...	21,956 ,,
Lead	... ...	45,857,424 lbs.
Nickel	... ...	26,282,991 ,,
Cobalt	... ...	?
Silver	... ...	27,878,590 ounces
Zinc	... ...	?

(In addition, there were produced 607,718 tons of pig iron from imported [Newfoundland] ore.)

Non-metallic.

Coal	... ...	10,411,955 tons
Asbestos ...	... .	63,349 ,,
Asbestic and asbestic sand	...	23,951 ,,
Petroleum ...	... ...	420,755 barrels
Pyrites	... ...	57,038 tons

In addition to products of less importance, a number of structural materials and clay products are also included in the returns. These returns have been modelled upon the mineral statistics of the United States, and thus copy faithfully all the mistakes of the latter, the principle having apparently been to get hold of a system that shall show the largest possible money value, irrespective of the consideration whether this is a true or a fictitious one. Thus the ores, or, as they are called in the returns, the metallic minerals, are valued by the amount of metal they contain, on the assumption that the whole of this metal can be extracted, and that its extraction and manufacture cost nothing; to get the grand total of the value of the mineral products, the total value of the coal mined is added to that of the metals thus calculated, though, of course, the manufactured value of a metal is made up in part, and often in large part, of the value of the coal used in smelting it; hence any coal used for smelting is valued twice over, and the same is true of the coal used in burning bricks, tiles, lime, &c. The values assigned are therefore so misleading that it appears better not to quote them. It is also surely incorrect to class arsenic, chromite, ochres, and pyrites amongst the *non-metallic* minerals. Although there are thus serious grounds for finding fault with the principles adopted in compiling the returns of mineral statistics, the work is, as usual, done thoroughly well, and gives evidence that the organisation of the Canadian Department of Mines has been put upon a highly systematic basis. H. L.

SCIENTIFIC RESEARCH IN AUSTRALASIA.[1]

THE Transactions and Proceedings of the New Zealand Institute form a very remarkable series of volumes, the contents of which deserve to be better known and appreciated in the mother country than would appear to be the case. They contain, amongst other things, the results of nearly half a century of investigation by New Zealand naturalists of the unique fauna and flora of their country, and local geologists and ethnologists have also contributed a large share to the imposing edifice of fact and theory which is gradually being built up. A generation of teachers, which included in its ranks such men as F. W. Hutton and T. J. Parker, could hardly fail to stimulate research—if stimulation were needed in a country where everything cries out for investigation.

The remarkable organisation of the New Zealand Institute, with its constituent societies in all the important centres of population, and the no less remarkable facilities for university education at the four university colleges, have no doubt also contributed largely to the result. Opportunities for original work have been abundant, and good use has been made of them. Much, of course, remains to be done in the future, and it will be very many years before New Zealand biologists have to seek "fresh fields and pastures new." In the meantime, the hope may be expressed that the New Zealand University may soon be able to see its way to an increase in the number of its science professors, accompanied by that necessary division of labour which has long been urgently called for. The professors themselves would then have more liberty for research work, and this is a matter of vital importance.

We believe there has never yet been a professorship of either botany or zoology, pure and simple, in New Zealand, and the botanical teaching has generally been in the hands of professors who have themselves specialised mainly in zoology. This fact makes the results attained all the more remarkable. The New Zealand University has always wisely insisted upon a course of general biology as the necessary foundation for both zoology and botany, and the fatal divorce which has taken place between the two subjects in the old country has thus to a large extent been avoided. We should be sorry to see this admirable arrangement upset, but surely some means could be devised whereby existing chairs could be divided without sacrificing the general biological training.

The forty-second volume of the Transactions and Proceedings of the New Zealand Institute marks a distinct advance upon its predecessors in the character of the illustrations, which in previous volumes have often left much to be desired. More care will have to be taken, however, in supervising the printing of the coloured plates. In the copy before us the registration of plate xxxi. is nearly an eighth of an inch out, producing a grotesque dislocation. One of the most interesting papers in the volume is "A Comparative Study of the Anatomy of Six New Zealand Species of Lycopodium," by J. E. Holloway, a pupil of Prof. A. P. W. Thomas; and Miss B. D. Cross has a well-illustrated paper on some New Zealand halophytes, treated mainly from the œcological point of view, in which the influence of Dr. Cockayne's work is clearly recognisable. Mr. Aston's "Botanical Notes made on a Journey across the Tararuas" deserves special mention on account of the beauty of the photographic illustrations.

Another noteworthy paper is that by Dr. C. Coleridge Farr and Mr. D. C. H. Florance, "On the Radio-activity of the Artesian-water System of Christchurch, New Zealand, and the Evidence of its Effect on Fish-life." The water from all the wells tested was found to contain a considerable amount of radium emanation, and when it first emerges from the well it has a very disastrous effect upon young fish and developing eggs. Experiments made in the fish-hatchery of the Canterbury Acclimatisation Society showed that the number of eggs dying increased in direct proportion to the amount of radium emanation present in the water.

We have also received two volumes of collected papers from the science laboratories of the University of Melbourne, published during the years 1906–9. We learn from Prof. Osborne's preface to the first volume that in March, 1908, the Government of Victoria made a grant of 1000*l.* to the University for the payment of scholarships in scientific research, and that in the two following years this sum was doubled. The result has been a marked increase in the amount of research by post-graduate students in science subjects.

The volumes before us contain numerous papers emanating from the departments of anatomy, biology, botany, chemistry, engineering, geology, natural philosophy, and physiology. These have been collected from very various publications and bound up together, and though they have been sorted out into two categories according to size, the resulting volumes are necessarily somewhat clumsy and awkward to handle. Unfortunately, also, they do not contain nearly all the papers published by members of the scientific departments of the university during the period selected, but they should serve to impress the supporters of the university with the large amount of valuable research work which is being done. As the different papers do not appear in these volumes for the first time, but were all originally published elsewhere, it is perhaps undesirable to attempt to notice them individually in this place. They form a highly interesting record of what is being done in the way of scientific research in the Melbourne University, and show a great amount of activity on the part of both teaching staff and students. A. D.

[1] (1) Transactions and Proceedings of the New Zealand Institute, vol. xlii. (for 1909).
(2) Collected Papers from the Science Laboratories of the University of Melbourne. 2 vols. (1906–9.)

THE MANUFACTURE OF VARIETIES OF COMMON SALT.

GREAT interest has been aroused among salt manufacturers by the announcement of the discovery of a new process capable of producing every variety of commercial salt in one plant and with great economy of fuel. The inventor is Mr. James Hodgkinson, of the firm of James Hodgkinson, Ltd., Pendleton, Manchester, makers of mechanical stokers. It is said that the patent rights for America have been sold to an American syndicate for 1,000,000*l.*, and to the Canadian Pacific Railway Company for Canada.

Up to the present time, salt has been manufactured by a process scarcely different from that used during the Roman occupation, namely, boiling down the brine in shallow open pans heated by coal fires. It is true that in 1839 Reynolds introduced the use of closed pans, in which the steam was passed from the first pan to the others, and a considerable economy in fuel effected, one ton of coal yielding four tons of salt, as against two tons in the case of open pans, which, however, still continued in use.

The chief features in the Hodgkinson process are the introduction of mechanical stokers for the fires, and the working of a plant consisting of seven pans, three closed and four open, heated by one fire. The quality and size of the salt crystals largely depend on the temperature, which can be so regulated in the new process as to produce every kind required.

The first pan is covered, and produces, by crystallisation alone, a table salt so fine that no grinding is required. From this pan proceed waste gases, which pass underneath and heat all the remaining pans, while the steam passes over to the succeeding pans and assists the precipitation of the salt. The second and third pans are also covered, and produce a slightly coarser variety, known as "dairy" salt. In the succeeding pans, all of which are open, the gases are at a lower temperature, and coarser salt in larger crystals is obtained. This is known as "fishery" salt, and is used in fish-curing. It should be added that there is an automatic flow of brine into the pans, and an automatic discharge of the salt produced.

The process, first successfully tried at Northwich, then extended to Port Sunlight and St. Helens, has resulted in such complete consumption of smoke that several large chimneys have been dispensed with. The success of the process must be assured if the hopes of the inventor are realised in practice. He claims that four or five times as much salt can be produced in a given time as compared with the old process, and that three tons of coal will be saved out of every four.

ARCHÆOLOGICAL RESEARCH IN ARKANSAS.[1]

MR. CLARENCE B. MOORE has issued another of his valuable memoirs on the prehistoric pottery of the United States. His last season's field work was on the St. Francis, Little, White, and Black rivers in Arkansas. Like all his other memoirs, this one is illustrated with maps and very numerous beautiful illustrations, many in colours, and all of large size, so that every detail is visible. Mr. Moore is still in the collecting stage of his work; generalisations we may expect at a future time. The principal sites along the St. Francis, although, as a rule, having mounds in connection with them, are in reality great dwelling-sites which have increased in height gradually through long periods of occupancy, and the aborigines, burying where they lived, have formed in course of time great cemeteries, all of which he believes to be pre-Columbian, since no object was found in any way indicating intercourse with Europeans excepting a bone comb, which, "though the shape is undoubtedly copied from a European model, the decoration points to Indian workmanship"; he asserts it is prehistoric.

The St. Francis valley has yielded more examples of its ware than has any equal area in the United States, and has been largely exploited by irresponsible collectors. The earthenware is shell-tempered. Quantity rather than quality seems to have been the aim of its makers, for the ware is often insufficiently fired, and the vessels are frequently thick and lop-sided. A high polish is almost absent. A very large proportion of the vessels are undecorated or with trivial decoration. Incised decoration is scarcely ever seen, the inferior surface of most of the ware being unsuited to incised decoration of excellent quality, even had it been attempted. Practically none of the vessels obtained by him are of types new to the pottery of the Middle Mississippi valley. The types of pottery have been well described by Prof. W. H. Holmes in his "Aboriginal Pottery of the Eastern United States" (20th Ann. Rep. Bur. Am. Eth). The most noteworthy find was a ceremonial "spear-head" of sheet-copper. Several vessels in the form of heads with fairly well-modelled faces were obtained, and some in the form of human figures. One burial of a very young infant had near by it a small bowl in which, upright, was a little effigy bottle.

Unlike the St. Francis river sites, which are on high ground, the sites on the White river and its upper reaches, the Black river, are on low, overflow ground, where archæological research is not likely to be rewarded; indeed, with a few trifling exceptions, no aboriginal objects had previously been obtained from this district. With one exception, no site of interest was found along the White river, and but three vessels of earthenware were encountered along the stream. Along the Black river, while some vessels were found, not one was of a character to warrant its transportation home. Although burials were fairly numerous, they were almost invariably unaccompanied by artifacts, a remarkable fact considering the custom of lavishing deposits upon the dead as practised by aborigines of neighbouring regions. The best find was a narrow, well-made ceremonial axe-head of green quartzite, 212 mm. in length.

A. C. HADDON.

[1] Journal of the Academy of Natural Sciences of Philadelphia. 2nd series, vol. xiv., part 2: "Antiquities of the St. Francis, White, and Black Rivers, Arkansas," by C. B. Moore, pp. 255-364 (Philadelphia, 1910).

THE COEFFICIENT OF SKIN FRICTION IN AIR AT MODERATELY HIGH VELOCITIES.

THE object of this study is to find a coefficient of turbulent friction readily applicable to the design of aërodynamic appliances such as aëroplanes and windmills.

It is assumed throughout that:—

(1) The surfaces on which the friction occurs are of reasonably smooth finish, and present no marked head resistance due to irregularities of surface.

(2) The velocities of the air relative to the surface are well above the critical values at which pure viscous shearing resistance is superseded by the generation of momentum in the contacting film or fluid, so that the skin resistance varies as the square of the velocity.

(3) The length of the surface in the direction of motion bears so small a relation to the dimensions perpendicular thereto that the diminution of the coefficient with the length is inappreciable.

The study is divided into two parts:—

(*a*) An analysis of the various methods of determining the skin-friction coefficient already known, with a tabular record of the numerical results already attained or thereby deducible, leading up to the most probable value of the said coefficient.

[(*b*) An experimental study made with the purpose of confirming the accuracy or otherwise of the said probable value. This is now in progress, the apparatus (an epicyclic differential dynamometer) being made. As this will not be ready for some considerable time, it may be useful to publish the comparative analysis beforehand.]

Symbols Employed.

British engineer's units—Pounds, feet, seconds. Force in lbs. wt.

f. Coefficient of skin friction.

C = about 0·7, being the coefficient of normal pressure on unit square surface, with unit velocity, and unit mass of air.

ρ. Mass of unit volume of air at normal temperature. About 0·08 pound per cubic foot.

A_1. Area subject to skin friction.

A_2. Area of mid-section or normal surface of a dirigible.

k. Ratio of skin friction on a dirigible to normal resistance on an area equal to the cross-section.

c. Coefficient of oblique air pressure (Lanchester). The value of this depends on the aspect ratio of the surface. From Duchemin's rule for square surfaces it is 2; Eiffel gives a value of 3; Lanchester gives hypothetical values between 2 and 3.

ξ. Ratio of skin friction on a double surface to the normal resistance of the plane of the same single-surface area.

β. Angle of incidence (Radians).

V. Relative velocity of air to surface.

l. Length of surface in the direction of flow.

A.

I.—*Frictional Resistance deduced from the Head, or Total Resistance of Dirigible Balloons.*

The resistance of a well-shaped dirigible is, like that of a ship, almost entirely due to skin friction. The aërodynamic resistance of cars, rigging, &c., is almost negligible in ratio to the skin friction, certainly not exceeding 30 per cent. thereof.

If, then, the area of the skin is A_1, and that of the maximum cross-section is A_2, and k is the ratio of the skin friction to the aërodynamic resistance of a normal surface with the same shape as the mid-section, this definition of k may be written:—

$$\frac{fA_1}{C\rho A_2}=k \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The coefficient k has been measured for several dirigibles, and forms the basis of this computation.

Name	Length	Diameter	A_1	A_2	k	f
Renard and Krebs	50·42 m.	8·4 m.	1330 sq.m.	55·4	0·4	0·000033
			(Espitallier, Genie Civil, 1902)			
Zeppelin III. ..	128	11 66	48000	100	0·45	0·000025
			(Moedebeck's Pocket Book)			
Lebaudy	53	10·3	2000	80	0·31	0·000030
				(Ditto.)		
Spherical Conoid.	6D	D	$6\pi D^2$	$\frac{1}{4}\pi D^2$	0·16	0·000014
			(Molesworth's Pocket Book[1])			
	Total ...					0·000102
	Mean value ...					0·000025
	Deduct 30 per cent. for other resistance ...					0·000008
						0·00001

The value 0·000025, seeing that it certainly includes some aërodynamic resistance due to imperfect form of envelope and the resistance of car and rigging, should be regarded as the absolute maximum.

II.—*Frictional Resistance deduced from the Efficiency of a Plane Aërofoil.*

According to Turnbull (*Physical Review*, March, 1907), the lift-to-drift ratio is a maximum for planes of an aspect ratio of two, when the angle of incidence is $3\frac{1}{2}$ degrees, and it has then a value of 5·1 ($3\frac{1}{2}$ degrees = 0·06 radian).

Employing Lanchester's notation, this ratio (also called by Turnbull the "efficiency")

$$=\frac{Cc\rho AV^2\beta}{\xi C\rho AV^2+Cc\rho AV^2\beta^2}$$

$$=\frac{c\beta}{\xi+c\beta^2}$$

c, according to Lanchester (compare Dines, Eiffel, and Rateau), is about 2·5, so that $\xi=0{\cdot}020$ for the double surface and $f=\xi C\rho=0{\cdot}000032$ for the double surface, or for the single surface 0·000015.

III.—*Frictional Resistance in Air deduced by Comparison with that of Water.*

The investigations of Froude have led to a fairly accurate knowledge of the frictional resistance of water, and it has been thought by many that a simple ratio exists between this and that of air in similar circumstances.

Froude's coefficients are between 0·003 and 0·005, the total resistance varying with a power of the velocity from 1·83 to 2·0 when there is considerable turbulence. It is probable that the lower density of air renders it more easily subject to turbulent conditions, so that there can be little doubt as to the approximate truth of the velocity squared hypothesis.

(*a*) Assuming that the friction is purely dependent on the density, since the density of water is about 800 times that of air, f may be $=0{\cdot}004/800=0{\cdot}0000052$.

(*b*) Assuming that the friction varies as the density, and also as the square root of the kinematic viscosities, an assumption consonant with hydrodynamic theory,

$$f=\text{sq. root of } 12\times0{\cdot}004/800=0{\cdot}000017.$$

IV.—*Zahm's Investigations.*

Prof. Zahm, by experimenting in a wind tunnel on boards, obtained a formula as follows:—

$$f=0{\cdot}000008\ l^{-0{\cdot}07}\ V^{18{\cdot}5}$$

for smooth surfaces and no vibration, increasing up to $f=0{\cdot}00001$ (total resistance varies with V^2) for turbulent conditions and buckram-covered surfaces.

V.—*Lanchester's Investigations.*

Index of velocity variation = 2.

Mr. F. W. Lanchester, experimenting with gliding models, and also with an aërodynamic balance (similar to that designed by Ritter von Loessl), obtained various results.

Nature of surface	Method	Coefficient
Mica	Gliding angle of models of variable area	0·000017
,, ...	Gliding angle of model ..	0·000016
Varnished cedar	,, ,, ...	0·000019
Polished ,,	Ballasted aëroplane ...	0·000005
,, ,,	Aërodynamic balance ...	0·000008
Glass paper ...	,, ,, ...	0·000013
		6) 0·000078
Mean value for moderately smooth surfaces		0·000013

VI.—*Collected Results.*

I. From the resistance of dirigibles ...	0·000017
II. Turnbull's observations	0·000015
III. Hydrodynamic theory and Froude's observations of water	0·000017
IV. Zahm's observations	0·000010
V. Lanchester's observations	0·000013
	5) 0·000072
General mean	0·000014

HERBERT CHATLEY.

[1] This result is apparently after Pole's figures, but the resistance seems to have been under-estimated.

BIOLOGY OF THE EEL-FISHES, ESPECIALLY OF THE CONGER.

DURING the Atlantic and Mediterranean cruises of the Danish research steamer *Thor*, in the winter of 1908–9 and summer of 1910, a very large material has been collected of the larvæ of the eel-fishes (Leptocephali). These belong to at least twelve different forms, and several of them can be referred to their parent species.

The material is specially rich in a few of the forms, and this permits of important conclusions being drawn with regard to the biology of these species. At the same time, it has yielded valuable information regarding the occurrence of the very youngest stages (pre-Leptocephali)—information which has long been desired and sought after; and, lastly, it has aided us in the determination of the age of the older Leptocephali, a question which the hitherto available information has been quite unable to settle.

The species of eel which is of the greatest practical interest in Great Britain is the Conger, and of this we have now a very large and complete material. Several hundred specimens have been taken—in all stages, from a length of only 9 mm. up to ca. 160 mm.

The larvæ are not difficult to determine, in part from the number of myomeres, which in ten specimens I have found to vary between 153 and 159, thus quite the same as in the adult Conger; below 35 mm. the most posterior

myomeres cannot be counted with certainty, but the pigmentation is sufficiently characteristic.

In the accompanying table (Fig. 1) I give a graphic summary of the Conger larvæ taken on the two cruises of the *Thor*. Without further explanation, it will be evident from this table that the *youngest stages*, of 1–4 cm. in length, have *only* been taken on the summer cruise, the older intermediate stages, of 5–9 cm., *only* on the winter cruise, whilst the full-grown Leptocephali, of

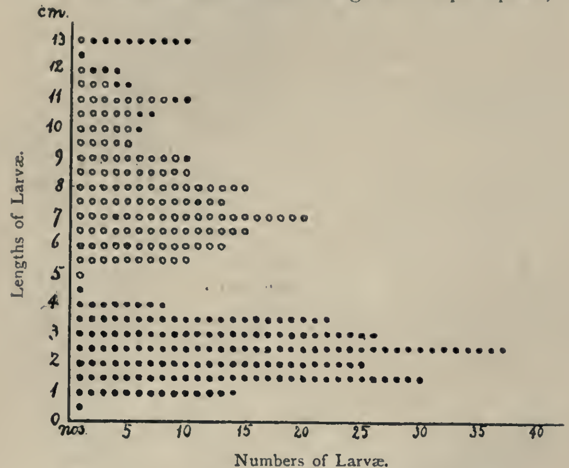


FIG. 1.—Conger larvæ. { • Summer cruise (vi, vii, viii). o Winter cruise (xii, i, ii).

ca. 12–13 cm. in length, were taken on both cruises, though mainly in the summer. From the sharp distinction between the youngest specimens taken on the summer cruise and the larger of the winter cruise, we are obliged to conclude that *the spawning of the Conger takes place mainly, if not exclusively, at a certain definite time of year, namely, in spring and summer.* We may further conclude from the material that the larval group of about 7 cm. is about half a year old, and that most of the larvæ of 12–13 cm., some of which are in process of transformation, are about one year old.

All the larvæ recorded in the table were taken in the Mediterranean or in the Atlantic off the Straits of Gibraltar. In earlier years (1905–8), when the *Thor* was working in the northern parts of the Atlantic, west of the British Isles, we also found several Conger larvæ during the period May to September, but these were all older stages, more than 12 and up to 16 cm. in length. The observations made on our last two cruises in the Mediterranean throw a new light on these older discoveries, for we now know that it is extremely easy to take the earliest Conger larvæ in the upper layers, when we know just *where* to find them. We may, in fact, conclude, with a high degree of probability, that the Conger does not spawn in the region examined by the *Thor* to the west of the British Isles, but further south in the Atlantic (Fig. 2, off the Straits of Gibraltar).

A more detailed account of the distribution of the different developmental stages will be given later, but on the accompanying chart I endeavour to summarise the occurrence of the youngest specimens, from 1–4 cm. long, all of which were taken on the summer cruise. It will be seen from this chart that *these earliest developmental stages were mainly taken over very great depths*, outside the 2000-metre line (or near this), but not in the many hauls which were made in the shallower waters. It appears, further, that the largest hauls (including newly hatched larvæ) were made at the deepest places the *Thor* had visited, namely, over depths of more than 3000 metres or about 3000 metres, in the Levant, the Ionian and Tyrrhenian Seas, as also in the deep basin between Sardinia and the Balearic Isles, where we have taken twenty to sixty larvæ in quite short hauls with pelagic apparatus.

These discoveries show that, when the time for reproduction arrives, *the Conger seeks out from the coasts to great depths, where it spawns mainly in the deepest and most central parts of the basins.*

In an earlier paper (1906) I suggested that the youngest larval stages of the eels might be bathypelagic, that is to say, living at great depths below the surface. Perhaps our most important discovery now is that *the earliest pre-leptocephalous stages of the Conger, as well as of the other four to five species the earliest larvae of which I know, really belong to the upper layers.* This can be seen from the hauls at any of our stations where such eel larvæ were taken in quantities. Our practice at each station was to make a series of hauls at varying depths, the length of wire out being 25, 100, 300, 1000, and 2000 metres, and the large quantities of the fry and eggs were always taken in the first, but few, or none at all, in the others. As the depth fished in could not have exceeded 15 metres, we must conclude that the youngest stages and the eggs belong normally to the uppermost layers of water. The older stages (Leptocephali), on the other hand, are also found in greater depths, 100–200 metres below the surface, as I have already shown in my earlier papers, and the life-history of the eel larvæ is thus no exception to the general rule applying to fishes with pelagic eggs, namely, that the earliest stages are passed at or near the surface, and that as development proceeds the larvæ sink down into greater depths.

The renowned Straits of Messina have also become famous in connection with our present subject as the first place where eel larvæ were found. So far as I know, the eel larvæ have never before been discovered in any quantity in the open waters of the Mediterranean, and this is the reason, I believe, why the reputation which the Straits of Messina obtained through the discovery of the Leptocephali there was, to a great extent, undeserved; in any case, the theories which the Italian observers founded on this discovery regarding the bathypelagic or demersal mode of life of the pre-Leptocephali and Leptocephali cannot be maintained. The conditions in the Straits where deep-sea forms and surface forms occur together at the surface are exceptional and abnormal, and the phenomena, biological and physical, we find there are not at all indi-

FIG. 2.—Chart of the Mediterranean and Atlantic, showing where the Conger larvæ were taken.

cative of the ordinary course of events. The pre-Leptocephali and the Leptocephali are just as much pelagic animals as, for example, the larvæ of the cod or haddock, and occur in the upper layers not exclusively in the Messina Straits, but everywhere in the various deep basins of the Mediterranean, as well as in the Atlantic.

With regard to the actual spawning of the eels, it is still undecided whether this takes place on the bottom or bathypelagically in great depths of the ocean. In our 1906 cruise we found the Leptocephali of the common eel in great numbers far out in the Atlantic over depths of 4000–5000 metres. Further, the largest quantity of murænoid eggs I have taken were found near the surface in the middle of the Tyrrhenian Sea over about 3500 metres. There is the possibility, therefore, that the eels seek out to these great depths in order to spawn bathypelagically, irrespective of the bottom, but unfortunately it will be very difficult to decide this question one way or the other.

Our present knowledge of the life-cycle of the eels may be summarised as follows.[1]

The eel-fishes spawn in great depths, how far from the surface we do not yet know. The eggs occur pelagically in the surface layers, and there give rise to the pre-leptocephalous stages, which also belong normally to the uppermost layers over great depths. Their whole organisation also shows that the pre-Leptocephali, as well as the Leptocephali, are true pelagic organisms. The Leptocephali likewise belong to the upper layers (high up at night, lower down in the day time), but there is the difference that during their prolonged existence they spread over greater distances and are also found over shallower waters than the pre-Leptocephali.

The first stages in the transformation also proceed pelagically, but thereafter the different species behave differently. Whilst some species during transformation go deeper down in the sea (*e.g.* Synaphobranchus), others (*e.g.* Conger and the common eel) undergo most of their metamorphosis in the upper layers. In their later life the former live in great depths, the latter in shallower water near the coast, and even in fresh water. When the time for reproduction arrives, all descend again into the oceanic depths whence they came, spawn but once, so far as we know, and never return. JOHS. SCHMIDT.

Copenhagen, February 8.

[1] Four species of Leptocephali, one of Tilurus, and first and foremost the two Conger species (*C. vulgaris* and *C. mystax*) form the basis of this summary.

REPORT OF THE CARNEGIE FOUNDATION.

THE fifth annual report of the president of the Carnegie Foundation for the Advancement of Teaching covers the year ending September 30, 1910. The report is divided into two parts. Part i. pertains to the current business of the year; part ii. is a discussion of the relation of the college and the secondary school.

The report shows that the trustees had in hand at the end of the year funds amounting to 2,222,811*l.*, consisting of the original gift of 2,000,000*l.* par value of 5 per cent. bonds and 200,000*l.* accumulated surplus. The income for the year was 108,776*l.* During the year sixty-four retiring allowances were granted, of which forty-six were in accepted institutions and eighteen in institutions not on the accepted list.

In the first part of the report the president of the foundation follows up the bulletin on medical education by a paper on the relation of the university to the medical school, in which he directs attention to the responsibility attaching to any college or university which undertakes medical education.

The second part of the report is a careful attempt to state the existing causes of friction between the secondary school and the college, and the loss of educational efficiency in the present methods of bringing pupils from the school to the college. The complaint of the college against the secondary school, and the complaint of the secondary school against the college, are set forth.

An extremely interesting part of the report is a statement of the observations of Oxford tutors upon the preparation of the Rhodes scholars. The strong points in the American youth's preparation are readily seen by these trained teachers, and the weaknesses which they find point directly to the superficiality and diffusion of the work done in the American secondary school and college.

The president of the foundation urges that this whole question be approached by secondary-school men and college men in a spirit of cooperation. Neither the certificate method of admission nor the piecemeal examination method have in his opinion solved the problem. He urges that the college must find a solution which will test better than the certificate or the piecemeal examination the fundamental qualities of the student, and which will at the same time leave to the high school a larger measure of freedom. He recommends a combination of certificate and examinations, the latter of a simple and elementary character, but calling for a high quality of performance, without which the candidate will not be admitted. For example, under this plan the boy who cannot write good idiomatic English would not be admitted to college at all, but would be sent back to the secondary school. The entrance requirements recently adopted at Harvard are quite in line with these recommendations. The president of the foundation urges a cooperation between the secondary school and the college, not as unrelated institutions, but as two parts of a common system of education. He argues that the interest of the great mass of high-school students must not be sacrificed to the interest of the minority who are looking toward college. He insists on a larger measure of freedom for the secondary school, but, on the other hand, he argues that the interest of the boy who goes to college and of the boy who goes from the high school into business are alike conserved by learning a few things well, not by learning many things superficially. The boy who has obtained such intellectual discipline is a fit candidate for college, whether he has studied one set of subjects or another; without this intellectual discipline he is unfit alike for college or business. It is therefore, in the opinion of the president of the foundation, the plain duty of the college, at the present stage of American educational development, to articulate intimately with the four-year high school and to leave to the secondary school the largest freedom so that it may educate boys, not coach them, but at the same time to require of the candidates for admission tests which rest upon high performance in the elementary studies and which mean mastery of the fundamentals. In such a programme lies the hope of scholarly betterment and of civic efficiency both for college and high school.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The legacy of 20,000*l.* bequeathed by the late Mr. John Feeney has been applied to the endowment of the chair of metallurgy, which is henceforth to be known as the "Feeney Chair of Metallurgy."

The Huxley lecture for this year is to be delivered by Prof. Henri Bergson, lecturer in philosophy at the University of Paris.

In addressing the Court of Governors at the annual meeting, the Vice-Chancellor referred with satisfaction to the recent grant of an additional halfpenny rate by the City Council, "which they all acknowledged had been generous." The principal (Sir Oliver Lodge) in his speech, which followed that of the Vice-Chancellor, defended the University against the charge of extravagance which had been brought against it in some quarters. He pointed out that "in this country we are behind in educational matters, and have been excessively economical when we ought to have been lavish in outlay." He stated that certain departments are better equipped in other modern universities in England, and that it must not be assumed that what Birmingham had done was "to be regarded as something out of the way and extraordinary." He also expressed the opinion that "it was highly important that universities, whatever aid they received, should not become appendages of State departments of the Civil Service. All our modern universities were experiments started by the nation in higher education, and no Government office or official was competent to control the highest education in the country. The only reasonable way was to trust the institutions and the experts called

together to manage them, because there were no better men, and though they made mistakes, it was better that such mistakes should be made individually than all over the country."

Cambridge.—The council of Trinity College has resolved to offer to the University the sum of 1000*l*. in the present year, to be invested for maintenance of buildings. The offer is made in the hope of expediting the erection of one or both of the proposed new buildings for physiology and experimental psychology.

The general board of studies will shortly proceed to appoint a university lecturer in moral science in succession to Dr. Keynes. The appointment will date from October 1. Candidates are requested to state the subject or subjects on which they are prepared to lecture. They are also requested to send their applications, with such testimonials as they think fit, to the Vice-Chancellor on or before Monday, April 24.

The Allen scholarship has been awarded to Mr. Hugh F. R. Smith, of St. John's College.

The next combined examination for sixty-eight entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 5, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences.

It is announced in *The Pioneer Mail* that his Highness the Nawab of Rampur has contributed a lakh and a half to the funds for the proposed Mahomedan University. At a meeting in Calcutta on February 14 last, his Highness the Aga Khan stated that the whole amount of money required is likely to be subscribed before the end of the present month, by which date it is expected the fund will exceed twenty lakhs.

The London County Council has issued a full report of the proceedings at the conference of teachers held under its auspices on January 5–7 this year. A descriptive account of the meetings of the conference was given in these columns on January 12 last (vol. lxxxv., p. 353), and it will be sufficient to point out that this official publication contains a verbatim report of the papers read and the discussions which took place. Copies of the report may be obtained from Messrs. P. S. King and Son, 2 and 4 Great Smith Street, London, S.W., price 1*s*. 6*d*.

We learn from *Science* that Dr. and Mrs. Robert W. Long, of Indianapolis, have given 40,000*l*. to the medical department of Indiana State University; that by the will of Mrs. Emily H. Moir, of New York City, Barnard College received 2000*l*.; and that Illinois College, at Jacksonville, Ill., received recently 1000*l*. from Mr. Edward F. Goltra, of St. Louis. This contribution is towards a new endowment of 30,000*l*. which the college is raising. Mr. Andrew Carnegie has contributed one-half of the amount; friends and old students have thus far contributed about 13,000*l*.

The Education Committee of the County Council of the West Riding of Yorkshire has issued a pamphlet giving detailed information of the conditions under which it awards scholarships and exhibitions. Provision is made for every grade of education, and facilities are offered to make it easy for the ambitious boy or girl to proceed on the educational journey from the elementary school to the university or technical college, so far as his or her ability permits. The needs of both men and women have been borne in mind. County major scholarships of the estimated value of from 60*l*. to 65*l*. are tenable at universities or university colleges, and county art scholarships of the value of 60*l*. per annum are tenable at the Royal College of Art. There are in addition county technological scholarships, scholarships for women, coal-mining exhibitions, agricultural exhibitions, exhibitions for the blind, and travelling scholarships. The capacity-catching net is certainly thrown very wide in the West Riding, and there should be very few Yorkshire students of talent unable to proceed with their education through lack of means.

The Department of Agriculture and Technical Instruction for Ireland will, as in previous years, conduct courses of instruction for teachers during the coming summer. Among the courses arranged may be mentioned those in experimental science and laboratory arts; in domestic economy; in hygiene, sick-nursing, and housewifery; in manual training in wood and metal; in practical mathematics and mechanics; and in rural science. All the courses mentioned will be held in Dublin. Teachers who attend the courses of instruction regularly and punctually will, as a rule, be allowed a sum of 3*l*. 10*s*. towards their expenses while living at the centre, and those who travel more than twenty miles to the centre of instruction will be allowed, in addition, third-class railway fare for one return journey. Teachers desiring to take advantage of the courses must fill up and return the appropriate form of application not later than March 31 to the offices of the Department, Upper Merrion Street, Dublin.

Copies of the report of the librarian of Congress and the report of the superintendent of the library building and grounds for the fiscal year ending June 30 last have been received from Washington. The reports, which are bound together, make a volume of 305 pages. The grants for the administration of the library proper and the copyright office in connection therewith amount for the present year to upwards of 98,000*l*. The report shows that there was a marked increase in the size of the library during the year under review; 90,473 books were added, 6822 maps and charts, and 17,215 prints, in addition to the pieces of music and volumes on music. A very interesting description is provided respecting the accessions to the division of manuscripts, of which, the report says, a numerical estimate is not feasible. We notice that the total number of visitors to the library building during the year was 768,911, being a daily average for 363 days of 2118.

A gift of 60,000*l*. by Mrs. Russell Sage to Cornell University is announced in *Science*. From the same source we learn that an increase in the income and in the building fund of the University of Wisconsin on the basis of a growth of 23 per cent. in the number of students in the last two years and of the constantly growing demand on the part of the people of the State for expert assistance from the University, is provided for in a Bill introduced in the State legislature. It provides for changing the present two-sevenths of a mill tax on the assessed valuation of all property of the State for maintaining the University to three-eighths of a mill. This will increase the general University income approximately from 125,000*l*. a year to 200,000*l*. a year. For new academic buildings and permanent improvements, the proposed legislation appropriates 60,000*l*. a year, of which 10,000*l*. annually is set aside for the purchase of books, furniture, apparatus, and equipment. The remaining 50,000*l*. a year is to be used for the construction of academic buildings, in the order of their greatest need, and for the enlargement and repair of present buildings. The regents of the University of Michigan, too, have applied to the legislature for a grant of 50,000*l*. for a science building. The need for more adequate accommodations for the natural sciences has been felt for a number of years, and was the subject of a memorial to the regents by the departments of botany, zoology, geology, mineralogy, and forestry in 1907.

The distribution of prizes and certificates to students of the Battersea Polytechnic was held on Tuesday, February 28. The principal, Dr. Rawson, in presenting his report, stated that he thought in every respect the report was a satisfactory one, there having been a considerable increase in the student hours, these, on the whole, being the best criterion of the progress of an institution. The examination successes included nine passes for the final B.Sc., five being in honours; seven students passed the intermediate B.Sc., and three the engineering intermediate examination. The principal added that the work of the Day Technical College, both in quantity and quality, was steadily rising, and that a full four-year course was in operation. A very gratifying feature was the demand which was being experienced for their students, in almost all cases positions having been found for all three-year students by the end of the session. Dr. T. J. Macnamara,

M.P., in addressing the students, said that the English people are rapidly coming to see that in the markets of the world the schoolmaster is the agent in advance. Our great past, glorious as it was, may be something of a handicap if we slavishly follow the paths that led to our being a great people. The governing forces of the universe are changing with a rapidly increasing momentum. Brawn put us where we were, but, under present conditions, will not keep us there. Nowadays a nation, to maintain its place, must have brain as well as brawn.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. C. S. **Sherrington** and Miss S. C. **Sowton**: Reversal of the reflex effect of an afferent nerve by altering the character of the electrical stimulus applied.—Dr. H. E. **Roaf**: Carbon dioxide output during decerebrate rigidity (preliminary communication). The object of this research is to determine the amount of energy required to maintain muscular rigidity in decerebrate cats. As an indication of the energy production, the carbon dioxide output was measured. The animals were maintained under constant conditions. The experiments were divided into two periods of two hours each. During the first period the carbon dioxide production of the decerebrate cats was measured, and during the second the carbon dioxide production, after abolishing the rigidity, was estimated. The results show that abolishing the rigidity by curare does not alter the carbon dioxide output, and hence there does not seem to be any more energy used to maintain the rigid condition than when the muscles are flaccid. Decapitation abolishes the rigidity, and at the same time lowers the carbon dioxide output. The cause of this lowering of the carbon dioxide output is being investigated.—Dr. Arthur **Harden** and W. J. **Young**: The alcoholic ferment of yeast-juice. Part vi.—The influence of arsenates and arsenites on the fermentation of the sugars by yeast-juice. The results of the investigation may be summarised as follows:—(1) When a suitable amount of arsenate is added to a fermenting mixture of yeast-juice and a sugar, it causes a large acceleration in the rate of production of carbon dioxide and alcohol. This enhanced rate differs from that produced by phosphate, inasmuch as it continues long after a chemical equivalent of carbon dioxide has been evolved. The arsenate, moreover, is found in the free state throughout the fermentation. (2) The rate attained increases rapidly with addition of arsenate until *optimum* concentration is reached, after which it decreases, at first rapidly and then more slowly. (3) The total fermentation produced depends on the particular concentration of arsenate employed, and may be either higher or lower than that given in the absence of arsenate. As the high rate produced by a suitable quantity of arsenate persists for a long time, very considerable increases in the total fermentation may be observed. (4) Glucose and mannose are similarly affected by yeast-juice in presence of arsenate, whereas fructose is much more rapidly fermented than these two sugars, and the optimum concentration of arsenate in its presence is greater. (5) The increased rate of fermentation of sugars in presence of arsenate is due to an acceleration of the rate of action of the hexosephosphatase of the juice, whereby an increased supply of phosphate is afforded. The action is therefore essentially different from that of phosphate, and it has been found that arsenate cannot replace phosphate in the fundamental reaction of alcoholic fermentation. (6) Arsenate also causes a considerable increase in the rate of autofermentation of yeast-juice and in the rate of fermentation of glycogen. This is mainly due to acceleration of the rate of action of the diastatic enzyme of yeast-juice (glycogenase). (7) The action of arsenites is similar to that of arsenates, but is much less marked. (8) Both arsenate and arsenite cause total inhibition of the fermentation when they are present in a high concentration, but the nature of this effect has not been ascertained.—Colonel Sir David **Bruce** and Captains A. E. **Hamerton** and H. R. **Bateman** (Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10): Experiments to ascertain if certain Tabanidæ act as the carriers of *Trypanosoma pecorum*. In the latter part of 1909 the commission noted that an outbreak of cattle trypanosomiasis due to *Trypanosoma pecorum* at Mpumu, Uganda, coincided with the appearance of swarms of *Tabanus secedens* in certain places where the cattle went to graze. In 1910 the following researches were commenced to ascertain if *Tabanus secedens* might be the carrier of this trypanosome. An investigation of the biting flies occurring where the cattle became naturally infected showed twelve species of Tabanus, five species of Hæmatopota, two species of Chrysops, *Glossina palpalis*, and a new species of Rhinomyza. Before this investigation, it was thought that some five or six species comprised all biting flies inhabiting the locality. *Glossina palpalis* was found inhabiting an inland stream having no connection with Victoria Nyanza, and situated six miles from the lake shore. Tabanidæ appear suddenly in great numbers in certain localities for a few months only, then as suddenly disappear. Hæmatopota was found in open swampy places and forests. Chrysops and Rhinomyza were comparatively scanty; found about fords of streams in the forests. The three species *Tabanus secedens*, *T. fuscomarginatus*, and *T. thoracinus*, were the most common of the Tabanidæ. Their eggs or larvæ were never found, and only wild flies were experimented with. The flies would not live in cages. Transmission experiments were carried out in a fly-proof kraal built amidst the natural surroundings. Sick and healthy calves were daily placed together in a compartment of the kraal in which the above-named species were set free, the experiments being performed with only one species of fly at a time. The flies only lived a few days, but were frequently observed to bite the cattle. A control calf was kept in a compartment of the kraal, to which no flies had access. Large numbers of flies of the above-named species were used, but no normal calf contracted the disease. Two series of dissections were made. First, of the wild flies, obtained near the laboratory, the same day they were caught; secondly, of wild flies, introduced into the fly compartment of the kraal, after they had had the opportunity of biting the infected calf therein. In the first series 138 *Tabanus secedens* and 49 *T. thoracinus* were dissected. Of the former, 5 per cent. showed a heavy infection of flagellates in the hind-gut, rectum, and proctodæum only; of the latter, flagellates were found in hind-gut, rectum, and proctodæum of 25·5 per cent. Inoculation of these parasites into white rats failed to cause disease. In the second series, liberated in the fly compartment of the kraal, 50 *T. secedens*, 24 *T. thoracinus*, and 37 *T. fuscomarginatus* were dissected. Two *T. secedens* were infected with flagellates, and one *T. thoracinus*. None of the *T. fuscomarginatus* were infected. Inoculation of these parasites into white rats also failed to cause disease.—H. M. **Leake**: Experimental studies in Indian cottons.

Geological Society, February 17.—Prof. W. W. Watts, F.R.S., president, in the chair.—Annual general meeting.—Prof. W. W. **Watts**: Presidential address. The consideration of geology as geographical evolution. The main factors of the geographical evolution of an area were considered to be the alternation of upward and downward movement. Each geographical cycle, passing from the period of maximum depression through uplift into terrestrial conditions, and then back again towards depression and submergence, would be expressed in the geological record by a corresponding set of deposits consisting of "thalassic," "shoreward," "terrestrial," "estuarine," and "thalassic" deposits, following each other in this order. Each of these phases was considered in some detail, and attention was directed to difficulties in interpretation and correlation, and to the principles according to which the depositional phenomena should be translated into terms of geography. Despite the fact that several cycles of geography and deposition had swept over Britain, there had been comparatively little repetition of phase in the deposits, and two or three examples were taken to illustrate cases of correspondence and non-correspondence of deposits formed during similar stages in the succeeding cycles. The careful and minute study of existing geographical conditions was strongly advocated as the key to the interpretation of the geological record, and it was

urged that the utmost possible use should be made of palæogeographical maps, both as a means of expressing ascertained fact and as affording a focus for new critical investigation. The association of the phases of earth-movement with igneous activity was next briefly treated, as also the connection of movement with rock-structure and existing physiography. Finally, geographical evolution was examined as the spur to organic evolution, and it was urged upon palæontologists that they should endeavour to ascertain to what extent periods of slow or rapid evolution corresponded with epochs of physical change.

February 22. Prof. W. W. Watts, F.R.S., president, in the chair.—R. H. **Rastall**: The geology of the districts of Worcester, Robertson, and Ashton (Cape Colony). After a brief description of the physiography of the district and the general sequence of the rocks composing it, in which the incompleteness of the stratigraphical record is especially noted, a detailed account is given of the structure and characters of the Malmesbury rocks of Worcester and the region near that town. These are shown to include a lower and an upper sedimentary series, predominantly gritty and slaty respectively, and evidently of great thickness, probably more than 20,000 feet. The upper division is pierced by granitic dykes, which have been subsequently crushed and foliated, forming "phyllite gneiss." Certain bands of limestone are metamorphosed by them to pure white marble. The distribution and characters of the rocks of the Cape and Karroo systems are only dealt with, in so far as they throw light on the principal subject of the paper, but a fairly full description is given of the occurrences of Enon Conglomerate, which is shown to occupy a series of isolated basins arranged along an east-and-west line, and to lie with a strong discordance upon all the older rocks. After a careful discussion of all the available evidence, it is concluded that the Worcester-Swellendam Fault, which has a maximum throw of probably 10,000 feet, is in great part of post-Cretaceous age, although there are indications of earlier movement along the same line of fracture. From a study of the dominant trend-lines of south-western Cape Colony, it is concluded that the district in question is situated at or near the central line of the syntaxis of two great sets of folds at right angles, which have assumed a fan-shaped arrangement in plan, and that the great fault is a line of fracture and subsidence running transversely across these lines of folding.—Baron Ferencz **Nopcsa**, jun.: Geology of northern Albania. The author had examined the greater part of the province of Skutari in western Turkey, and recognised three distinct structural units, namely, the north Albanian platform, the folded Čukali, and the eruptive region of Merdita. In the first region Mesozoic limestone of all periods predominates, in the second region Mesozoic radiolarian chert is found, while in the third region Mesozoic clastic rocks, volcanic tuffs, and eruptive masses are abundant. The first and third units are not folded, but are, at least in part, overthrusts from the north and south respectively above the second (intermediate) unit, which is strongly folded. In northern Albania Upper Carboniferous and Permian rocks are also distinguishable, and there is an Eocene flysch.

Zoological Society, February 21.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—R. **Lydekker**: *Tragelaphus buxtoni*, an antelope obtained by Mr. Ivor Buxton in Abyssinia.—E. G. **Boulenger**: Varieties of the spotted salamander (*Salamandra maculosa*). One of the principal results of the author's study was to lay greater stress on the disposition of the spots than on their actual form, size, or colour, and to define two principal forms in Central Europe, which had not previously been separated with sufficient precision, notwithstanding their well-marked geographical distribution. The author further dealt with some of the experiments of Dr. Kammerer, of Vienna, and the conclusions arrived at by him with regard to coloration in relation to environment.—G. A. **Boulenger**: A collection of fishes from the Lake Ngami basin, Bechuanaland, made by Mr. R. B. Woosnam.—Dr. F. D. **Welch**: Gibbons of the genus Hylobates, and on a Siamang gibbon, recently living in the society's gardens, with notes on skins in the British Museum (Natural History).

MANCHESTER.

Literary and Philosophical Society, February 21.—Mr. Francis Jones, president, in the chair.—Dr. Alfred **Holt**: The boric acids. Experiments were described on (1) the rate at which orthoboric acid loses water when heated to different temperatures; (2) the changes in the vapour density of orthoboric acid on heating; (3) the freezing points of solutions of ortho-, meta-, and pyroboric acid; and (4) melting points of mixtures of orthoboric acid and boric anhydride. From these experiments the following conclusions were drawn:—(1) metaboric acid is probably a definite compound; (2) no evidence is found for the existence of boric acids containing less water than the meta acid; (3) only orthoboric acid exists in solution, and it is present in simple molecules; (4) metaboric acid cannot be regarded as an equimolecular mixture of orthoboric acid and boric anhydride; (5) fused mixtures of orthoboric acid and boric anhydride, in which the molecular ratio of the latter to the former compound exceeds 4:1, can exist in a vitreous metastable and crystalline stable form.—J. E. **Myers** and Dr. A. **Holt**: The hydration of metaphosphoric acid. Experiments were described by which it was shown that pyrophosphoric acid is formed as an intermediate compound in the hydration of metaphosphoric acid. It was further shown that the hydration did not take place according to any simple scheme, and a method of estimating meta acid in a solution of all three varieties by means of barium chloride was described. From the depression of the freezing point of aqueous solutions of various varieties of pyro and meta acids, it appears that, when these acids are prepared by dehydration of orthophosphoric acid, there occurs association of the molecules, but when prepared by decomposition of the lead salts by hydrogen sulphide, simple molecules result. The peculiar "crackling" phenomenon which accompanies the solution of one form of meta acid was shown.

DUBLIN.

Royal Irish Academy, February 11.—Dr. F. A. Tarleton, president, in the chair.—W. M'Fadden **Orr**: Extension of Fourier's and the Bessel-Fourier theorem. The author shows by application to some illustrative physical problems how certain defects as to uniqueness and differentiability in the expansions of the former paper (Proc. Roy. Irish Acad., vol. xxvii., A, 11) may be remedied. These problems include the motion of the system consisting of a stretched elastic string and a number of elastically connected particles at each end, in extension of a simple case considered by Lord Rayleigh ("Theory of Sound," § 135), the analogous problem involving the motion of a circular or annular membrane, and analogous problems in heat conduction. The expansions are also extended so as to apply to the same vibrating systems when subject throughout to viscous forces, in which case the displacement of the string satisfies the equation

$$d^2\phi/dt^2 = c^2d^2\phi/dx^2 - fd\phi/dt + gd^3\phi/dx^2dt.$$

—A. W. **Conway**: The application of quaternions to some recent developments of electrical theory. Two examples of quaternion treatment are given for the purpose of showing the superiority of this method over vectors, by considering two cases in which the latter would lead to great complication. The subjects taken are Poincaré's Fredholm solutions for Hertzian waves, and Einstein's and Minkowsky's formulæ of relativity.—Rev. M. F. **Egan**: The linear complex and a certain class of twisted curves on twisted curves such that the degree of any cycle of the curve is equal to its class. Relations between such curves and null-systems in three-space.

February 27.—Dr. F. A. Tarleton, president, in the chair.—R. Lloyd **Praeger**: Clare Island survey: report of progress during 1910. During the second year's field work on Clare Island and its neighbourhood great advances have been made. About fifty workers visited the district during the year, for periods ranging from one to three weeks. Simultaneously with this report, the first instalment of the results of the survey are presented to the academy. It is intended to finish the field-work during the present year. In connection with the Clare Island survey, the following papers were read:—N. **Colgan**: Marine mollusca. The author gives a very full account of the marine mollusca collected during the years 1909 and

1910 in the various dredgings and shore collectings made in the Clew Bay area. The list includes 246 species, and of these no fewer than 133 were taken in a single haul of the dredge. Amongst the species enumerated are two nudibranchs, here for the first time recorded as Irish, *Thecacera pennigera* and *Actaeonia cocksii*. New records are also given for many rare species, the most interesting being *Circulus striatus* (*Trochus duminyi*), which was twice dredged in the bay.—J. N. **Halbert**: Water mites. At least four species previously unknown to science, and ten others new to the British Islands, are recorded.—H. Wallis **Kew**: False scorpions.—James **Wilson**: Agriculture and its history. The initial purpose of this paper is to determine the approximate dates at which agricultural plants and animals, not native to the island, might have been introduced. To do this, it is necessary to consider the history of agriculture first of all in Ireland, and then in Great Britain and the neighbouring Continent, in order to trace the immigration of their plants and animals westwards. The paper becomes, therefore, a concise historical note on British and Irish agriculture, with special regard to such data as bear upon its initial purpose.—N. **Colgan**: Irish names of animals and plants. The writer has collected on Clare Island and about Clew Bay current Gaelic names for about 120 species of native plants and animals. The dialectic variants found in use in other parts of Ireland are appended to those collected in the Clew Bay area, and supplementary notes are added on the folk-lore found in association with certain of the animals and plants referred to.

Paris.

Academy of Sciences, February 20.—M. Armand Gautier in the chair.—J. **Carpentier**: Remarks on a modified pattern of the spherometer due to M. Nugues.—M. Eugène Tisserand was elected a member of the section of free academicians, in the place of the late M. J. Tannery.—Carl **Störmer**: The structure of the solar corona. Calculations have been made for a series of trajectories of electrified corpuscles, emanating normally from the solar surface, and assuming that the magnetic field of the sun is identical with that of an elementary magnet placed at the centre with its axis along the axis of rotation. The results of these calculations are shown graphically, and compared with the form of the corona at the time of minimum sun-spot frequency.—Maurice **Gevrey**: Partial differential equations of the parabolic type.—A. **Buhl**: The geometrical application of the formula of Stokes.—Ed. **Sarasin** and Th. **Tommasina**: The action of slight elevations of temperature on induced radio-activity. From the experiments described, it is concluded that even small elevations of temperature act on metals which have been rendered radio-active, causing an immediate and temporary increase in their loss of activity.—F. **Leprince-Ringuet**: The law of transmission of heat between a fluid in motion and a metallic surface.—Paul **Lebeau**: Uranyl nitrate and the nature of its ethereal solution. The uranyl salt forms a compound with the ether used for its solution, and there is a slight heat evolution. This compound can be crystallised out by cooling the solution with a mixture of solid carbon dioxide and acetone.—V. **Auger** and M. **Gabillon**: A new method for the estimation of sulphuric acid and sulphates. The sulphate is distilled with a mixture of potassium iodide, phosphoric, pyrophosphoric, and phosphorous acids. The sulphur is given off quantitatively in the form of sulphuretted hydrogen, the latter being absorbed and estimated in the usual manner. The method fails with barium sulphate.—G. **Darzens**: Condensation of halogen derivatives with $\beta\beta$-dimethylglycidic ester. Dimethylglycidic ester, treated with zinc and an alkyl iodide, gives substituted lactic acids of the general formula $Me_2.CH.CR(OH).CO_2H$, and from these, by dehydration, a series of unsaturated acids can be obtained.—E. E. **Blaise** and L. **Picard**: The action of the chlorides of the α-alkoxylacids on the mixed organo-derivatives of zinc.—A. **Guilliermond**: The reproduction of *Debaryomyces globosus* and on some phenomena of retrogradation of sexuality observed in yeasts. These yeasts form one of the best examples known of a group in the course of evolution towards parthenogenesis.—Mlle. G. **Promsy**: The influence of acidity on germination.—M. **Mazé**: The excretion of mineral and organic substances by roots and stomata.—R. **Legendre** and H. **Piéron**: Experimental contribution to the physiology of sleep. The authors' experiments lead them to the conclusion that there exists in the cerebral plasma, blood, and especially in the cephalo-rachidian fluid of dogs suffering from insomnia, a substance possessing a hypnotoxic property. This disappears when heated to 65° C., and causes an overpowering demand for sleep.—M. **Piettre**: Muscular autolysis of pathological origin.—Paul **Hallez**: A non-parasitic Bdelloura of the Antarctic seas.—Jean **Effront**: The Bulgarian ferment. A comparison of total and volatile acids produced by the action of seven Bulgarian ferments of different origin shows that the bacterium isolated by Bertrand is clearly differentiated from the rest. This ferment produces more total acid and less volatile acids than any of the others.—H. **Bierry**: The digestive ferments of manninotriose and its derivatives.—J. L. **Dantan**: Fecondation in *Paracentrotus lividus* and *Psammechinus miliaris*.—Raphael **Dubois**: The disease affecting crayfish in the lake of Nantua. The malady is shown to have been caused by a yeast, *Rhabdomyces Duboisii*.—Jules **Amar**: The expenditure of energy in walking. The energy expenditure depends on several factors, speed, rhythm, displacement of the centre of gravity, oscillations of the body, &c., and follows no simple law. The effect of carrying a load has been studied, and also the most economical speed for walking.—Léon **Bertrand**: The prolongation of the North Pyrenees sheets in the western Pyrenees.

February 27th.—M. Armand Gautier in the chair.—A. **Chauveau**: The phenomena of visual inhibition which may accompany the re-association of the two retinal images dissociated by the prisms of the stereoscope. Some experiments on stereoscopic vision with most interesting results are described in detail. The inhibiting action of one eye on the other is most strikingly shown in one experiment. When the left eye is cut off by a screen all the details of the figure are clearly seen with the right eye; on removing the screen all the details of the figure disappear.—A. **Laveran** and A. **Thiroux**: The identification of the pathogenic trypanosomes. An examination of the method proposed by Levaditi and Mutermilch, and based on the attachment of the trypanosomes to leucocytes. It has been found that although the method yields useful indications, it cannot be relied upon for an absolute diagnosis.—E. L. **Bouvier**: Observations in the Pycnogonomorphs and principally on *Pentapycnon Geayi*.—Paul **Sabatier** and A. **Mailhe**: Direct esterification and saponification by catalysis (see p. 54).—Jean **Chazy**: The determination of uniform functions in the neighbourhood of points where they cut.—S. **Bernstein**: The approximation of continued functions by polynomials.—C. **Cailler**: The linear pentaseries of solid bodies.—M. **d'Ocagne**: The nomographic determination of the path pursued by a ship in the course of varied movement.—M. **Bertin**: Observations on the preceding note.—Jean **Becquerel**: The duration of the phosphorescence of the uranyl salts. The duration of the phosphorescent emission is independent of the temperature (down to −193° C.) for uranyl sulphate and nitrate, whilst uranyl acetate, tartrate, oxalate, and other organic salts follow the ordinary rule, and the phosphorescence is of longer duration at the lower temperatures.—Henri **Abraham**: Relays and electric servo-motors.—M. **Ferrié**: The measurement of the lengths of Hertzian waves. Various types of wave meters are indicated and full particulars given of the method of calibration of one of them.—L. **Gay**: Mixtures of acetic acid with normal liquids.—Eugène **Fouard**: A practical method for the preparation of semi-permeable membranes applicable to the measurement of molecular weights. The method is based on the use of a collodion membrane, prepared according to the description of E. Roux and Salimbeni; this is permeable to a true solution but impermeable to the ultra-microscopic particles of a colloid. If such a collodion tube containing a tannic acid solution is placed in a gelatine solution, the membrane is modified in such a manner that whilst remaining freely permeable to water, it becomes impermeable to substances such as sugar in solution, and thus fulfils the condition of a semi-permeable membrane. Such a cell can be used to prove that two solutions are isotonic with much greater accuracy than is obtained by the method of de Vries.—

Daniel **Berthelot** and Henry **Gaudechon**: Nitrification by the ultra-violet rays. An aqueous solution of ammonia under the action of ultra-violet light forms some nitrite. A solution of ammonium nitrate under similar conditions gives off oxygen mixed with nitrogen and nitrite is formed. The effects of ultra-violet light are generally similar to those of ferments.—Emile **André**: The combination of amines with acetylenic ketones. The preparation of β-substituted ethylenic aminoketones.—Charles **Moureu** and Amand **Valeur**: Isosparteine, a case of stereoisomerism of nitrogen.—Henri **Coupin**: The comparative toxicity of plant essences on higher plants. The action of the essential oils from a large number of plants has been studied from the point of view of their action on wheat germs. The great majority prove to have clearly toxic effects.—G. **Gastine**: The use of saponins for the preparation of insectidal emulsions and liquids for the destruction of insects and cryptogams. The addition of saponin to such liquids is shown to be distinctly advantageous.—Henri **Bierry**, Victor **Henri**, and Albert **Ranc**: The action of ultra-violet light on glycerol.—J. **Renaut**: Mitochondria of the globular cells of the hyaline cartilage of mammals.—Ph. **Négris**: The existence of the trias at Mt. Ktypas (Messapion) and the importance of the gap between the Trias and the Cretaceous in Greece.

DIARY OF SOCIETIES.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—(1) The Absorption Spectra of Lithium and Cæsium; (2) Dispersion in Vapours of the Alkali Metals: Prof. P. V. Bevan.—On the Ionic Solubility-product: J. Kendall.—Note on the Electrical Waves occurring in Nature: Dr. W. H. Eccles and H. M. Airey.—The Action of Animal Extracts on Milk Secretion: Prof. E. A. Schäfer, F.R.S., and K. Mackenzie.

MATHEMATICAL SOCIETY, at 5.30.—On the Reduction and Classification of Binary Cubic Forms which have a Negative Determinant: G. B. Mathews.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Laying and Maintenance of Transmission Cables: C. Vernier.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Fading of Dyestuffs: J. W. Lovibond.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 9.—Recent Advances in Turbines: Hon. C. A. Parsons, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the bearing of the Principle of Relativity in Gravitational Astronomy: W. de Sitter.—The long-period Variable *RT* Cygni: A. N. Brown.—On a New Family of Periodic Orbits in the Problem of Three Bodies: E. W. Brown.—On the Determination of the Places of Reference Stars and Fundamental Stars by Photographic Methods: H. H. Turner.—On the Oscillating Orbits about the Triangular Equilibrium Points in the Problem of Three Bodies: E. W. Brown.—On the Problem of Distribution in Globular Star Clusters: H. C. Plummer.—Measures of Double Stars: Royal Observatory, Edinburgh.

MALACOLOGICAL SOCIETY, at 8.—On the Recent Species of Vulsella; on a New Species of Phasianella: E. A. Smith.—On the Value of the Gasteropod Apex in Classification: T. Iredale.—*Valvata Woodwardi*, n.sp., and *Sphærium Bulleni*, n.sp., from the Forest Bed (Cromerian) of West Runton, Norfolk: A. S. Kennard.

PHYSICAL SOCIETY, at 8.—Demonstration of the Working of the Gyro Compass: G. K. B. Elphinstone.—Note on an Electrical Trevelyan Rocker: Dr. W. H. Eccles.—Notes on the Tilted Gold-leaf Electroscope: Dr. G. W. C. Kaye.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Pioneer Journey in the Purcell Range, British Columbia: Dr. T. G. Longstaff.

ROYAL SOCIETY OF ARTS, at 8.—Applications of Electric Heating: Prof. J. A. Fleming, F.R.S.

TUESDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Crystalline Structure: Mineral, Chemical, Liquid: Dr. A. E. H. Tutton, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Resumed discussion* on School Lighting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electrification of a Portion of the Suburban System of the London, Brighton and South Coast Railway: P. Dawson.

FARADAY SOCIETY, at 8.—Some Properties of Aluminium Anode-films: G. E. Bairsto and R. Mercer.—The Weight of a "Normal" Litre of Hydrogen Chloride and the Atomic Weight of Chlorine: F. P. Burt and Dr. R. W. Whytlaw-Gray.—A Physico-chemical Study of Mercury-sodium Alloys or Sodium Amalgams: E. Vanstone.—On Surface Effects between Mercury and certain Solutions, and an Electro-chemical Method of Estimating Dissolved Oxygen: Dr. S. W. J. Smith and W. F. Higgins.

WEDNESDAY, MARCH 15.

ROYAL SOCIETY OF ARTS, at 4.30.—The Adulteration of Food: Colonel C. E. Cassal.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—What can we learn from Rainfall Records?: Prof. H. H. Turner, F.R.S.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Some Photomicrographs illustrating the Morphology of the Organisms concerned in the Production of Acute Intestinal Toxæmia in Infants: Dr. Ralph Vincent.—Anomalies in Objective Screw Threads: F. W. Watson Baker.—(1) On some New Objectives and Eye-pieces by R. Winkel of Göttenberg; (2) An Objective Mount with an Iris on the Variable Microscope: W. Nelson.

THURSDAY, MARCH 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Gametogenesis of the Gallfly, *Neuroterus lenticularis*. Part II.: L. Doncaster.—The Action of the Venom of *Echis carinatus*: Sir T. R. Fraser, F.R.S., and Dr. J. A. Gunn.—Further Researches on the Development of *Trypanosoma gambiense* in *Glossina palpalis*: Colonel Sir D. Bruce, F.R.S., and others.—Spontaneous Cancer in Mice: Dr. M. Haaland.

ROYAL INSTITUTION, at 3.—Giants and Pygmies: Prof. A. Keith.

LINNEAN SOCIETY, at 8.—On the Brown Seaweeds of the Salt Marsh: Miss S. M. Baker.

ROYAL SOCIETY OF ARTS, at 4.30.—Education in India: C. H. A. Hill.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address: E. B. Ellington.

FRIDAY, MARCH 17.

ROYAL INSTITUTION, at 9—Water Supply: J. H. Balfour-Browne.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Production of Water-gas: Alwyne Meade.

SATURDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 16, 1911.

THE KAISER-WILHELM SOCIETY FOR THE PROMOTION OF SCIENCE.

GERMANY, and its head, the Emperor, have again shown the world their gratitude for the achievements of science; if desired, the word gratitude may be interpreted in the sense of "favours to come." Not content with endowing the universities and technical high schools from the Exchequer with what appear to us relatively enormous sums, a society has been founded, under the "protection" of the Emperor, for the advancement of science. It is instructive to note the difference between their method and ours. Both countries possess what is called "technical education"; but while we have founded schools in considerable number, destined to capture the workmen (who seldom attend) and the prospective foremen, they have aimed at the education of the manufacturers and the works managers. Instead of numerous institutions giving elementary science instruction, they have a few, imparting the most advanced. Instead of a system of small scholarships, intended to bribe the clever children of the lower middle class, they leave it to the parents to find out that their children, suitably trained, are equipped for their lifework, and will, if they are diligent, be certain of reasonable incomes, and respectable positions.

In this latest enterprise, too, the Germans have appealed, not to the moderately well-off, but to the rich. Membership of the new society may be acquired by private persons, or by firms, on the condition of an initial contribution of 20,000 marks (1000*l.*), payment of which, by special resolution of the Senate, may be distributed over several years, and besides this, an annual contribution of 1000 marks a year, commutable by a lump sum of 40,000 marks, or 2000*l.* The members are to be elected by the Senate, a body chosen by themselves at a general meeting, which must be held once each year, in February, but may be summoned also at any time by the president, or by any two members. Members of the Senate, consisting of at least ten members chosen by the contributors, hold office for five years; to it belong other members, not necessarily donors but *Gelehrte, i.e.* savants, or other persons who may be deemed useful, nominated directly by the Protector, that is, by the German Emperor. The election of members by the Senate requires the Protector's confirmation before it becomes absolute. Rules exist for the resignation of members and for the removal of defaulting members. The Senate meets twice a year, and holds a statutory meeting in March; it may also be summoned at other times by the Protector, by its Executive Committee, or by request from a third of its members. It elects a president, two vice-presidents, two treasurers, and two secretaries; the election of the three first also requires confirmation by the Protector. These form the executive committee of the society.

The object of the society is designated in its title, and in its first statute; it is "to promote the sciences, especially by the foundation and support of scientific institutes of research."

Readers of NATURE will have already read a translation of the address delivered at the opening of the society in presence of its Protector, by Prof. Emil Fischer, of Berlin, printed in the issue for February 23. The daily papers have informed us that at the celebration of the centenary of the Berlin University held last October the Emperor announced that this society had at its disposal a capital of half a million sterling. It is proposed to devote its income to the equipment of institutes in which men already eminent in their respective subjects will be installed. They will have the right to take student-assistants, *i.e.* young men, who wish to graduate in one or other of the universities; they will thus be able to pursue research, aided as much or as little as they please. Such a position was held, as member of the Berlin Academy, by Prof. van't Hoff, whose recent removal by death the whole scientific world deplores. He had a free hand, was not obliged to give any formal lectures, or to take part in the active management of the University, but was allowed, with the help of students, to work out his own problems in his own way, and his work on Stassfurth salts has been of great technical value. His words to the writer were, many years ago, that he thought it right to help his adopted country to solve its commercial problems, and that he had attempted to do so. But it must be understood that no such expectation is necessarily entertained of the incumbents of chairs at the proposed institutes; the progress of *science*, not necessarily of its industrial application, is contemplated. Our neighbours have learned the lesson that science, like virtue, brings its own reward.

It is wonderful how deeply the spirit of trust in science has penetrated the whole German nation. When Prof. Ostwald, many years ago, appealed to the Saxon Government for money to build his physico-chemical laboratory, the Socialists in the Saxon Parliament voted for the grant to a man, believing that greater expenditure on pure science would contribute to greater industrial opportunities. This spirit, which permeates the German people, from the Emperor on his throne to the representatives of the peasants, causes admiration; would that it could inspire imitation!

One is led to speculate on the cause of this. Why is it that the people of Germany have such sympathy for scientific endeavour? The reasons are many.

First, and above all, is the discipline which the German people have undergone by their military training; more are thus prepared for practical life in a measure which cannot be otherwise attained. It has its disadvantages; on the whole, the people are not so self-reliant, but they become more trustworthy machines. Second, there is a deeper understanding of scientific achievements and their bearing on industry. This manifests itself in many ways; the German Government is not above asking for, and acting on, scientific advice. The social position of the savants, scientific and literary, is therefore assured, and the incomes of the higher posts compare favourably with those earned by professional men and manufacturers. This higher social standing secures attention to those who tender advice. Third, there is a constant ex-

change between academic and industrial posts; many men leave chairs to become managers of factories; many men enter the teaching and investigating profession from factories. Chemical and physical factories, too, there form a training school for the younger scientific experts; where many are employed, the more advanced communicate their knowledge and the results of their experience to the junior members of the scientific staff; in fact, they have apprenticeship at its best. Here, in prosperous times, the manufacturer thinks that he has no need of scientific assistance; in times of bad trade he believes that he cannot afford it. And, lastly, the process of training the people has gone on in Germany for nearly a hundred years. Rewards have been given, not to successful examiners, and not in the form of scholarships; but have been earned in the battle of life, for which ample preparation has been given.

This spirit of trust in science has permeated to the highest in the land; that it has been fertile in practical results is amply proved by the inception of the Kaiser-Wilhelm Society for the furtherance of science.

MIMICRY IN THE BUTTERFLIES OF AFRICA.

African Mimetic Butterflies; being Descriptions and Illustrations of the principal known instances of Mimetic Resemblance in the Rhopalocera of the Ethiopian Region, together with an Explanation of the Müllerian and Batesian Theories of Mimicry, and some account of the Evidences on which these Theories are based. By H. Eltringham. Pp. 136+x plates and map. (Oxford: Clarendon Press, 1910.) Price 50s. net.

THIS valuable work is in chief part devoted to the "Descriptions of Mimetic Associations in African Rhopalocera," illustrated by nine beautiful coloured plates (ii–x) and by a most useful map of Africa. This—the main object of the book—is preceded by an excellent introductory account of the structure and classification of butterflies, and of mimicry and its relationship to other uses of form, colour, and pattern. The introduction is illustrated by the admirable first plate, showing the characters of the fore-feet of the principal butterfly groups. The discussion of special objections to the theories of mimicry, and a consideration of the evidence by which they are supported, are wisely left to the concluding pages of the text. A useful bibliographical list and an excellent index complete the work.

The extraordinarily rapid growth of knowledge on this subject at the present day is seen in the fact that important new light has been already thrown on certain conclusions in the few months that have elapsed since the appearance of the volume. Thus on p. 31 we read of the family raised by Mr. St. Aubyn Rogers from a female *Hypolimnas misippus* somewhat intermediate between the type and the form *inaria*, and of how the females, without exception, turned out to be *inaria*. But since the day of publication Mr. Rogers has bred in the same locality, Rabai, near Mombasa, another family from an *inaria* female parent, and in this instance all the female offspring were *misippus*! It should be mentioned in connection with this hitherto unpublished result that *misippus* and *inaria* females are about equally common in the locality where the families were reared.

Again, when the book was published it was safe to assert (on p. 96) that the *planemoides* female form of *Papilio dardanus* is restricted to the areas where its *Planema* models are abundant; but Mr. Rogers has now sent an example of it from the neighbourhood of Rabai, and Mr. G. F. Leigh an evidently closely allied very rare form from Durban, the former much to the east, the latter immensely to the south of any locality from which the models have been recorded.

Then the comparatively few African examples of mimicry within the Nymphalinæ have been increased by the recent observations of Mr. W. A. Lamborn that *Diestogyna gambiae*, the female of which resembles the abundant *Catuna angustata*, is constantly to be found in the company of this species.

Our knowledge of mimicry in Africa is progressing at a very rapid rate. To name only the principal naturalists who are directing their attention to this subject at the present moment, we have Mr. A. D. Millar and Mr. G. F. Leigh in Natal, Mr. C. F. M. Swynnerton in south-east Rhodesia, Mr. St. Aubyn Rogers in the Mombasa district, Mr. C. A. Wiggins at Entebbe, and Mr. W. A. Lamborn in the Lagos district. The present writer has found it most inspiring to be associated with all these keen observers and to receive many times in each year the tidings of new discoveries and the material on which they were based.

Mr. Eltringham's work will be of the utmost assistance to these and other naturalists, and it is to be hoped that it will be available in every African centre accessible to students of nature.

It will also be clear from the brief account of the plan and contents of the work that it is certain to be quite as valuable and efficient in stimulating and guiding the beginner as in aiding the expert in the search for fresh discoveries.

A careful and critical study has revealed comparatively few mistakes. All that have been detected are mentioned below, and in a book so full of statements of fact, the list must be regarded as a short one.

In mentioning *Cethosia* (p. 39, n. 2), the Oriental mimic of *Danaida*, it would have been well to point out that we here meet with one of the very rare instances of mimicry in the male, but not in the female. The mimicry is confined to the upper surface, and can hardly be looked upon as "remarkably accurate" in any species of this genus.

The male of *Planema macarista* should have been mentioned on p. 45 as a model of the *aurivillii* form of female of *Acraea alciope*. In both shape of wings and pattern the resemblance to this *Planema* is closer than to *P. poggei*, the model given by the author—a conclusion very clearly expressed in the arrangement of plate viii., but inadvertently omitted from the text.

In discussing, on p. 52, the scanty and somewhat imperfect mimicry of the abundant Danaine, *Tirumala petiverana*, the author omits the important consideration that the species is a *recent* intruder from another area—an intruder still retaining a close resemblance to its nearest Oriental allies.

In speaking, on p. 58, of the "black and white" varieties of *Pseudacraea lucretia* approaching the Danaine model *Amauris echeria*, the author is evidently referring to the individuals in which the normal white markings are to a greater or less extent replaced by ochreous.

It would have been appropriate to place *Acraea esebria* among the mimics of *Planema aganice* and its form *montana* (pp. 73–5). Furthermore, *aganice* is not "confined to the Natal region," but occurs in south-east Rhodesia and probably much farther north along the east coast. *A. esebria*, too, is not only southern (p. 81), but eastern in distribution.

Entebbe is given as the only locality of *Pseudacraea hobleyi* on p. 78, but its female, originally described as *tirikensis*, was first collected by Mr. C. A. Wiggins in a more eastern part of the circumference of the Victoria Nyanza, viz., Tiriki and Nyangori. It has been also received from Toro.

The Pterothysanid moth *Hibrildes neavei* is not "bisexually mimetic, and corresponds to the two sexes of *Acraea anemosa*" (p. 103). The mimetic *Hibrildes* is only known as a female, which probably belongs to one of the previously known non-mimetic males.

The admirable account of the most wonderful mimic in the world, *Papilio dardanus*, is accompanied by plate x, entirely devoted to the forms of this species and the allied *P. meriones* of Madagascar. The part of the preliminary list on p. 92 would have been better, from the point of view of evolution, as well as that of geographical distribution, in the order *polytrophus*, *dardanus*, *tibullus*, *cenea*. A more serious error in the same part of the list is the inclusion of the female forms *dorippoides* and *trimeni* in the sub-species *cenea*, instead of *tibullus*, although both are correctly placed in the full account on p. 100. The male of *dardanus* is inadvertently described as black and white on pp. 93–4, although its "pale yellow ground-colour" is correctly spoken of on p. 97. The males of *tibullus* (East Africa) are characterised by the strong development of the black submarginal band in the hind wing. Those of *cenea* (South Africa) differ in the smaller development of this feature. It increases rapidly as we pass northward, the *cenea* males being transitional into those of *tibullus*. The account on p. 100 conveys a nearly opposite impression.

The classification of so complex a subject as mimicry, under the limitations imposed by the ordinary printed page, must always be a matter of great difficulty. In some respects the author has not grappled with it very successfully. Thus his admirable account of the mimics of *Danaida chrysippus* does not seem to be very happily arranged. The species follow the order of the following column, the members of no single family or sub-family being all together:—

1. *Hypolimnas misippus*: Nymphalinæ.
2. *Pseudacraea poggei*: ,,
5. *Acraea encedon*: Acræinæ.
8. *Mimacraea marshalli*: Lycænidæ.
4. *Argynnis hyperbius*: Nymphalinæ.
7. *Acraea mima*: Acræinæ.
6. *Acraea wigginsi*: ,,
9. *Cooksonia trimeni*: Lycænidæ.
3. *Diestogyna iris*: Nymphalinæ.

In spite of this dislocation of the groups in the text, we find that all four Nymphalinæ are near together on plate ii, while the three Acræinæ and the two Lycænidæ are also together on plate iii. The most obvious sequence on the plates is that indicated by the numbers to the left of the column, a sequence far better than that adopted in the text. It is, in fact, the best possible arrangement, except for the position of *Argynnis hyperbius*, which, being restricted in Africa to Abyssinia, is best placed at the head of the list—as far as possible from all the rest. It would then be followed by the wide-ranging *H. misippus*, the only Nymphaline mimic with which it is associated. The remaining seven species, together with *H. misippus*, form a very natural group, some of them wide-ranging, the others, except the more equatorial *A. wigginsi*, especially characteristic of northern Rhodesia.

Having in view the needs of naturalists who are beginning the study of mimicry in butterflies, and we hope that large numbers of them will seek the valuable and important help offered in this beautiful work, it would have been advantageous to make the group-names a prominent feature in the descriptions of the plates, and also to print comprehensive descriptive titles beneath the plates themselves and above the descriptions of each. Thus plate ii. might have been briefly explained as "*Danaida chrysippus* and its Nymphaline Mimics." The arrangement of models and mimics in separate columns in the description of the plates is an admirable feature, as also is the printing of the names of the species beneath the figures on the plates themselves.

The succession of the models in the text might also, we think, be improved. Thus the deeply interesting series of Planemas with *Pseudacraea* mimics, begun on p. 65, is interrupted (pp. 66–9) by the great black-and-red combination ranged round *Acraea egina*, and by the purely Nymphaline association of *Crenis* and *Crenidomimas* (p. 70), and then again resumed on pp. 70, 71, *et seq.*

The author has wisely preceded his account of mimicry by a classification, on pp. 11, 12, of the chief butterfly groups, with a few of the main features by which each is distinguished. Such a classification will be of great value to those who are beginning the study of mimicry in the field, and have not the means of referring to the literature of the subject. It is a pity, however, that the Brassolinæ and Morphinæ are separated from their close allies, the Satyrinæ, by the intercalation of the Acræinæ and Heliconinæ—these latter being themselves similarly cut off from the Nymphalinæ, to which they bear so close an affinity. The author is here following in the main the key given by Mr. Roland Trimen in his South African Butterflies; but in this great work a linear arrangement based on affinity is printed on the opposite page, and is adopted throughout the volumes.

It is also unfortunate that the division of the "Heliconidæ" of Bates into Ithomiinæ and Heliconinæ is recognised neither in the classification nor in Mr. Eltringham's further discussion of the groups on pp. 17, 18. The composite nature of the "Heli-

conidæ" was fully accepted and explained by Bates in his paper on mimicry, where he speaks of the "Danaoid" and the "Acræoid" Heliconidæ. And since Bates's time the strong difference on which he insisted has been further emphasised by creating a separate Nymphalid sub-family, the Ithomiinæ or Neotropinæ, for the larger group, the "Danaoid Heliconidæ." *Ituna* and *Thyridia* are mentioned on p. 18 as belonging to the Danainæ; but the latter genus is Ithomiine, as Fritz Müller proved in 1879; and the author's argument in favour of mimetic approach is much strengthened by the great width of the interval between it and *Ituna*. The omissions and errors in this and the last paragraph are, however, concerned with tropical American butterflies, and do not greatly affect the value of a work on African Rhopalocera.

The author's arguments are clear and convincing, and he handles his intricate subject with great skill. The following line of reasoning is, however, open to criticism.

Speaking of the female of the Oriental *Argynnis hyperbius*, which, over nearly the whole area of its distribution, mimics *D. chrysippus*, but in Australia resembles its own male, and is non-mimetic, the author concludes:

"Since it has become established in Australia before the advent of the Danaine, mimicry of the latter is unnecessary for its continuance."

We are not convinced that this reasoning is sound. It may well be that the representative of *D. chrysippus* has not existed in Australia for a sufficient length of time for the mimicry to have originated; but the above argument seems to imply that a well-established indigenous form would never be influenced by an invading model. There is good evidence that such a change is ultimately wrought, as we see in the effect of the Old World Danaidas upon the North American *Limenitis* (*Basilarchia*), and of the Oriental Tirumalas (*Melinda*) upon the Ethiopian Papilios, so beautifully illustrated by Mr. Eltringham on plate iv of the present work. If these Danaines had not invaded the areas of which we speak, there is little doubt that the species of *Limenitis* and *Papilio* would be still living, but of course without their present mimetic patterns. A certain average proportion of destruction takes place in every generation. The advent of a dominant Danaine model does not necessarily alter this proportion numerically, but affects its quality. Whereas variations in the direction of the model were previously distributed at random among the eliminated and the survivors, they now tend, in each generation, to be more thinly scattered in the former set, more thickly in the latter. And the same conclusion holds for every step by which an elaborate likeness is finally produced.

The above considerations doubtless supply at least in part an interpretation of polymorphism in mimicry—the fact that a single mimicking species often appears in two or more quite different forms resembling different models. For when—by the spread of either itself or the mimic—a new and dominant model, A, comes into relationship with the mimic of an older model, B, the same conclusion holds. The eliminated proportion of the mimic will now for the first time tend to contain less, the surviving proportior more, of any variation in the direction of A, and afte a time the mimic may resemble both A and B. Often, but by no means always, such a process is transitional affording the means by which the mimic finally come to resemble A in one part of its range, and B i another. A good example is to be found in the femal of *Acraea alciope*—a tangled problem most skilfull unravelled by Mr. Eltringham not many months ago The usual western female of this species mimics th common pattern of the western male Planemas Further east, at Entebbe, this pattern, although i occurs, is by no means dominant, and the ordinar form of female *alciope* mimics the male of *Planem macarista*, and both sexes of *P. poggei*. But rar examples of the western mimic are still to be foun among the *alciope* females at Entebbe, and of th eastern mimic on certain parts of the west coast The probability that the younger mimetic pattern almost certainly the eastern—has been reached throug dimorphism, is extremely strong.

The author alludes to this deeply interesting subje of polymorphism in mimicry—shown by the recen researches of Dr. Karl Jordan to cover a far wide area than has been hitherto supposed—and infers o pp. 62, 63 that the only interpretation is to be found i Bates's hypothesis of a palatable mimic resemblin a distasteful model:

"We are forced . . . to the conclusion that specie which in the same locality produce polymorphi mimetic forms are Batesian mimics, and that the valu of the multiple varieties lies in the distribution of th mimetic forms amongst a corresponding number o models, thus avoiding the risk of the edible mimi becoming more numerous than its distasteful mod a state of things which would lead to a disastrou increase in the amount of experimental tasting b insectivorous animals."

In other parts of his work the author himself compel us to doubt the cogency of this reasoning, for h figures and describes such polymorphic mimics amon the highly distasteful Acræas—for instance, *A. jodutt* with its two forms of female at Entebbe, and th wonderful series of mimetic patterns exhibited b *A. johnstoni* in British and German East Africa.

There are a few typographical errors, such a "survivials" on p. 23, which we should scarcely hav expected in a book produced by the Oxford Universit Press, and should also have anticipated that its exce lent readers would have directed the attention of th author to an awkward slip in the construction on l. from the bottom of p. 78, as also to a few "spl infinitives" scattered through the pages.

The abundant names of species and genera ha been very accurately printed. We notice only a sing error—*Pseudobazis* for *Pseudohazis*, on p. 118. Amo names of persons *Guillème* is printed for *Guillemé*.

Mr. Eltringham's monograph is the first attem to set forth a nearly full account of mimicry in t butterflies of one of the great tropical regions. has very wisely selected Africa for his purpose. examples are far more numerous and perfect th those of the Oriental region; yet they are manageal

and not bewilderingly complicated like those of tropical America. Africa, too, is especially rich in naturalists who are waiting to be inspired and encouraged, as they will assuredly be by the present work. The author is to be congratulated upon the fine volume and the beautiful plates which are the outcome of his labour of love. It cannot be long before he may be congratulated upon their fruitful results. E. B. P.

THE GEOLOGY OF EGYPT.

Geological Map of Egypt. Scale 1 : 1,000,000 (six sheets) and reduction of the same to the scale 1 : 2,000,000. (Cairo: Survey Department, 1910.)

SOON after the occupation of Egypt by a British military force in 1882, the late Prof. Huxley, then president of the Royal Society, directed attention to the valuable opportunity that was afforded for the extension of our geological knowledge in that interesting country. He instanced the valuable series of scientific memoirs that had been prepared by French savants during the occupation of the country at the beginning of the nineteenth century, as an example worthy to be followed. Following his advice, the Royal Society appointed a "Delta Committee" to arrange for explorations, which it seemed desirable to undertake, and made various grants from its funds to defray expenses. The War Department of the Government, on being applied to by the Royal Society, agreed to lend the service of some of the engineer-officers, then in the country, to supervise the work.

As the result of these arrangements, borings were put down at a number of points in the Nile Delta, and reports on the materials sent home were submitted to the society by the Delta Committee in 1885 and 1897, and were published in the Royal Society Proceedings.

But in 1893–4 an engineer-officer, Captain H. G. Lyons, already known in this country by his geological work in the Bagshot area, was employed on patrol work in the oases of Kharga and Dakhla and in the desert routes to the south of them, and he took the opportunity thus afforded to him for making a number of geological observations in the district, which proved to be of great value and interest. Two years later the Egyptian Government decided to establish a geological survey of the country, and to place it under the direction of Captain Lyons. A staff of surveyors was formed, consisting of four young geologists from the Royal College of Science—Messrs. Barron, Beadnell, Hume, and Ball—and for a time Dr. Blankenhorn acted as palæontologist to the survey. The first named of these surveyors, after doing much excellent work, fell a victim to the climate of the Sudan in 1906. A number of very valuable memoirs by Captain Lyons and his staff have been published, some of which have been already reviewed in the pages of NATURE.

As Egypt and the Sudan have no good topographical maps to be placed at the disposal of the geological staff, topographers have had to be attached to each of the geological surveying parties; in this branch of the work Mr. F. W. Green, of Cambridge, a good archæologist, has often served as a volunteer. In 1898 Captain Lyons took over the charge of the whole of the survey departments of Egypt, while continuing his direction of the geological work.

It is not possible here to enumerate all the advances made in our knowledge through the labours of the little staff of geological surveyors in Egypt, but especial mention may be made of the important palæontological discoveries of Mr. Beadnell, aided by Dr. Andrews, in the Fayum, which included the finding of the wonderful Arsinotherium, and the ancestral forms of elephants and whales. Scarcely less interesting and important are the results obtained by Dr. Hume in his surveys of the Sinaitic peninsula, and of the eastern and south-eastern deserts of Egypt; and by Dr. Bell in his work around several of the oases and cataracts.

The results of all these researches are incorporated in the new geological maps of Egypt now issued. In spite of the existence of considerable blanks, these maps are a very great advance on any that have hitherto appeared. The oldest fossiliferous formation recognised is the Carboniferous, but considerable areas have to be mapped as "Nubian sandstones," portions of which may be of different geological age; there are also beds of gypsum, the position of which in the geological series is in some cases still doubtful. The Cretaceous strata are divided into Cenomanian, Senonian, and Danian, while the extensively developed Eocene strata have been distributed in three local divisions. Strata referred to the Miocene and Pliocene also occur, while Pleistocene and more recent deposits obscure wide areas. The larger-scale map forms six sheets, and the smaller a single sheet; all these are admirably printed in colour, and corresponding maps with hill-shading have also been issued by the Survey Department.

The survey staff has lost its original director, Captain Lyons, and also Mr. Beadnell, but it has been reinforced by the appointment of Mr. H. T. Ferrar, the geologist of Captain Scott's first Antarctic expedition; there have also been several other geologists who have served temporarily on the staff. The work is carried on at the present time under the directorship of Dr. W. Fraser Hume, who has had such a wide experience in desert-work, and is responsible for the maps which form the subject of the present notice. We are glad to learn from the last issued report of the survey that Dr. Hume proposes to write a general sketch of the "Geology of Egypt," this work, from such capable hands, will be looked forward to by geologists with much interest.

J. W. J.

THE BEGINNINGS OF BOTANY.

Landmarks of Botanical History. A Study in Certain Epochs in the Development of the Science of Botany. Part i., Prior to 1562 A.D. By E. L. Greene. Pp. 329. (City of Washington: Smithsonian Institution, 1909; Smithsonian Miscellaneous Collection, part of vol. xliv.)

DR. GREENE has contributed to the history of the progress of botany a work that bears evidence of unwearied research into the labours of

botanists whose influence on the science is realised by few, and whom it is well to remember with respect and gratitude. The book is wholly devoted to the early beginnings of the knowledge of plants, and to the revival of their study in the fifteenth and sixteenth centuries. It is not a work to be taken up to pass a leisure half hour. One feels disposed at times to question the author's presentation of his subject, but when the book has been read through one feels that it has well repaid the effort in the suggestive lights it has thrown on the past, on problems that are still with us, as well as on others that are no longer problems because solved for us by those early botanists. The treatment of the subject makes this book a valuable complement to the well-known "History of Botany" by Prof. Sachs, and there is much additional information in it.

Dr. Greene frequently is drawn into philosophical discussions in the definitions of his subjects. He defines the science of botany for the present work as occupied with the contemplation of plant as related to plant, and with the whole vegetable kingdom as viewed philosophically—not economically or commercially—in its relation to the mineral on one hand and to the animal on the other. From this point of view he recognises the beginnings of the science in the study of plants as plants, apart from their real or supposed economic worth. He finds true botanical science in the natural groups of popular language, and even in such terms as "herbs," "trees," and "grass," and still more clearly in such as "clover," "oak," &c. The correlation in value or kind of these and the like with the "genera" of systematic classification is insisted on. He concludes his introduction with impressing the view that "the essence and substance of botany proper are organography and the logical deductions we may draw from organography. The line of development of organography—as including terminology—is that along which a truly coherent and philosophic account of botany must be written."

A brief chapter is devoted to the Rhizotomi, whose maxims—so readily condemned as superstitions—he gives reasons to regard as in many cases judicious and well-founded.

By far the greater part of the book is occupied with brief biographies and detailed consideration of the work of five writers: Theophrastus of Eresus, Otto Brunfels, Leonhard Fuchs, Hieronymus Bock (Tragus), and Valerius Cordus. Short chapters on Greek and Roman writers after Theophrastus, on the early German writers, and on Euricius Cordus, father of Valerius, complete the volume.

Few botanists can claim to have gained a knowledge from his own writings of the part filled by Theophrastus in the progress of botany. To most Dr. Greene's estimate of his work will prove a revelation of a very surprising kind. The minute and careful analysis of the information contained in the two books that have survived, in an unfortunately imperfect state, shows that he was a genius and investigator far in advance of other botanists of his time. A recapitulation is given at the close of the chapter indicating seventeen heads regarded as "elements of universal botany of which Theophrastus appears to have been the discoverer and first promulgator." While it may be felt in regard to some of these that Dr. Greene is disposed to press the point unduly, the larger part are of such importance as to justify the claim to a front rank among botanists, and to show the inadequacy of the judgment expressed on him in Sachs' book.

Brief notices of Dioscorides, Varro, Virgil, Pliny, Galen, and others, bring out the contrast of these with Theophrastus, their inspiration being chiefly the study of plants for their useful or harmful properties, though they also added at times to the knowledge of plants as plants. During the long period of more than twelve centuries after the time of Galen, the natural sciences, instead of advancing, fell much into decay, and were in part represented by such works as the "Ortus Sanitatis," filled with grotesque figures and strange perversions of the truth.

The reawakening from this condition is placed by German historians of the science, such as Meyer and Sachs, in the sixteenth century, when the "Herbarum Vivæ Iconoes," of Otto Brunfels, was issued, and was succeeded by, among others, the works of Fuchs, Tragus, and Valerius Cordus. Brunfels and Fuchs, he points out, busied themselves almost wholly with plants as medicinally valuable; and their books are little more than compilations illustrated by figures of the plants to which they believed their borrowed descriptions referred. These figures were excellent in comparison with those in use previous to Brunfels, but in other respects neither Brunfels nor Fuchs can be shown to have made any important step forward. Fuchs introduced his "Historia Stirpium" with "An Explanation of Difficult Terms," from which his views on the structure of plants can be gathered, and are found in general to be retrograde from those expressed by Theophrastus.

Bock or Tragus (1498–1554) had a different point of view from Brunfels and Fuchs, and may deservedly be accepted as having opened the new era of botany. He studied plants for their own sakes; and, possibly in part from inability through poverty to employ illustrations in his "New Krauterbuch," he sought to describe them so clearly as to make it possible for others to recognise them from the descriptions alone. He wrote his books in German instead of the customary mediæval Latin; a translation into Latin being afterwards issued for use in other countries. He merely names the common and well-known plants, describing the scarcer and previously unknown forms. His method required, and was based on, very careful personal investigation; and he thus was able and was led to make important contributions to the science in various directions. Dr. Greene discusses Tragus' views on classification, nomenclature, ecology, &c., very suggestively and justly, with full recognition of his great merits but also calling attention to errors.

Euricius Cordus is given a place of honour for his sole botanical work, in which he points to defects in the study of botany in his day, but still more as the father and teacher of Valerius Cordus. The latter died at the age of twenty-nine, while travelling in Italy, but had won reputation by a work on the preparation of medicines published during his lifetime

He had travelled extensively in remote parts of Germany, had discovered many more plants than had been made known since the revival of botanical study in Germany, and had described these carefully in a work, "Historia Plantarum," left in manuscript. This was published some years after his death, edited by Conrad Gasner, who, by desire of the publisher, employed illustrations (prepared to accompany Tragus's work) to illustrate the descriptions of Cordus, to which they were occasionally incorrectly fitted. From a careful study of the descriptions, Dr. Greene shows cause to regard Valerius Cordus as of rare ability and insight, and esteems him to have been immeasurably the greatest of the "German fathers of botany." Among the services to botany ascribed to him we are told that "he is the inventor of the art of phytography"; that in all descriptions "attention is given to the morphology and life-history of the plant in as far as is known to him"; that new terms are employed expressing new ideas and points of view in the science, and that new conceptions appear in regard to inflorescences, flowers, fruits, and seeds. In taxonomy he shows clearer views with regard to species, and his groups were more often based on relationships than were those of his predecessors. A number of his groups of generic rank stand good, though in most cases the names given by him were needlessly changed by Linnæus. He paid heed to internal structure (so far as that could be determined by him, that is, by the unaided eye), and to physiology, as regards prefloration, modes of climbing, and similar features of plant-life. He also gave attention to the varieties of cultivated fruits, of which excellent descriptions are extant by him. What he succeeded in doing suffices to show how grievous a loss botany sustained in his early death.

VECTOR ANALYSIS.

Éléments de Calcul vectoriel, avec de nombreuses Applications à la Géométrie, à la Mécanique, et à la Physique mathématique. By Prof. C. Burali-Forti and Prof. R. Marcolongo. Édition française traduite de l'Italien et augmentée d'un Supplément par S. Lattès. Pp. vi+229. (Paris: A. Hermann et Fils, 1910.) Price 8 francs.

THE variety of matter contained in this small book shows the condensing power of vector notation, especially when combined with a concise literary style. The theoretical part includes the elements of the barycentric calculus, as well as a vector analysis in which vectors are written either in single letters, or in the form B–A, where A, B are points. Scalar and vector products are treated separately, so that quaternions do not come in. Special points to notice are that a scalar product has given to it the sign opposite to that assigned by Hamilton; the effect of this is that if α, β, γ are three orthogonal unit-vectors, $\alpha^2=\beta^2=\gamma^2=1$, and versors have to be treated by introducing a symbol i, such that $i^2=-1$, and is *not* a vector. There is a good deal to be said for this; but it is most unfortunate that the authors take the clockwise sense of rotation for the positive one, especially considering the use of vectors and vector products in physics.

The applications include geometrical, mechanical, hydrodynamical and electrical formulæ. Specially to be noted are the proofs of Green's theorem and its congeners, Stokes's theorem of circulation, and Hertz's formula for variation of flux.

There is an appendix, partly historical, partly critical and even polemic. Probably every reader will find something here with which he cordially disagrees; but there is one statement that deserves special attention. We believe that the authors are right in thinking that the final notation of the vector calculus will be based on Grassmann's "Ausdehnungslehre," as improved and modified by subsequent writers. The Hamiltonians will have nothing more than a sentimental grievance if this proves to be the case. Nothing can upset, or even modify, the quaternion calculus, because it is a definite type of linear algebra; the main question now is whether *this* algebra is the best for the treatment of physical, and especially electrical, problems. Judging by the attitude of Gibbs, Heaviside, and Lorenz (to name only these), the answer appears to be no.

There is very little fear that a really convenient notation will not be ultimately agreed upon; it will probably be invented by a physicist. Meanwhile, dispassionate observers will derive some amusement, as well as much instruction, from the lively controversies of the champions of this or that particular symbol, as if its retention or rejection were of vital importance in itself. For instance, our authors seriously object to a symbol such as $[\alpha\beta]$ for a scalar product, on the ground that functional symbols are invariably placed on one side of the operand! The example of $\int y dx$, where $\int () dx$ is practically a functional symbol, shows that the statement is barely true, except in an artificial sense; but even if it were strictly true, this would be no reason for regarding it as a necessary law of mathematical notation.

G. B. M.

MAP-MAKING.

The Theory of Map-Projections, with special reference to the Projections used in the Survey Department. By J. I. Craig. Pp. iv+80. (Cairo: National Printing Department, 1910; Ministry of Finance, Egypt Survey Department.) Price 200 milliemes.

THE subject of map projections is one in which the English language is strangely deficient, a deficiency the more apparent when contrasted with the wealth of Continental literature on the subject. Those interested in the higher theory of map-making will, therefore, welcome the appearance of this little treatise, which seems to give in a compact and practical shape all the essentials of this attractive branch of the geometry of surfaces. Starting with a statement of the problem to be solved, and an allusion to possible improvements in nomenclature; the term projection itself, in the meaning of a representation in accordance with any law, for instance, is not a particularly happy one; a history is given of the adop-

tion of the Gauss conformal meridional projection for the maps of the survey of Egypt. A general discussion of the figure of the earth, and the geometry of the surface of a spheroid, is then entered upon, leading the way to the theory of the representation of such a surface on a plane sheet and the involved balancing of errors. These general results are then applied to the standard projections, so that, while special attention is devoted to the Egyptian mapping, the major part of the book is of quite general application. The methods of investigation are, in many cases, new, and the mathematical forms concise and elegant.

As an interesting example of specialisation, we may note the investigation, on p. 61, of the Mecca retro-azimuthal projection, which would provide a map giving the true bearing of Mecca at any point.

The great variety of projections used for the maps of different countries gives rise to certain inconveniences, and it is an arguable point whether it would not be possible and desirable to reduce this number to a few standard forms by international agreement. What has already been accomplished in the case of the 1/1,000,000 map of the world might be extended to apply to other scales. We commend the subject to the attention of the next International Geographical Conference. It must always be bōrne in mind that while the selection of a suitable projection is important for atlas or general maps upon small scales, it is comparatively unimportant for large-scale survey maps produced in sheets, so long as each sheet is projected separately. The errors due to defects in the projection are always small compared with those due to the distortion of the paper upon which the map is drawn or printed.

E. H. H.

OVERHEAD AND UNDERGROUND ELECTRIC LINES.

Lignes Électriques Souterraines. Études, pose, essais, et recherches de defauts. Pp. 207.

Lignes Electriques Aériennes et Souterraines. Études, pose et essais. Pp. 181. By C. Giradet and W. Dubi. (Grenoble: J. Rey; Paris: Gauthier-Villars, 1910.) Price 5 francs each.

THE superscription on each of these volumes: "Bibliotheque de l'eleve-ingenieur," seems to indicate that they are written by and for graduates of engineering colleges, and this impression is confirmed by an introduction contributed by Prof. J. Pionchon, of the Dijon University, in which we are told that the "library" is intended to form a kind of post-graduate instruction to engineering students. To expect students shortly after they have graduated to be able to become authors on technical subjects and write books, which shall be good enough to serve as further instruction to other students which may graduate a year or two later, is hardly reasonable; but in the present case the difficulty is partly overcome by the circumstance that one of the authors is not a student fresh from college, but evidently a man of considerable practical experience in overhead power-lines and cable work.

Yet the result of the collaboration is rather disappointing. The books are neither scientific—in the sense of showing the connection between engineering practice and scientific principles—nor are they very practical in the sense of containing definite instructions. There is a little of each, and a good deal of what may be described as general talk on the subject, and containing little which is not self-evident to a man of average intelligence. Thus, when the authors tell us that overhead power-lines should be so constructed that copper may be added as the demand for power increases, everybody will agree, but is it necessary to labour so obvious a matter? On the other hand, some of the general talk is misleading. Take the statement that cables for very high pressure have no practical importance, since cables are only used within towns, that is, over relatively short distances; or the recommendation to earth the middle wire in a three-wire system at every junction box. Then, again, we find ten pages of what may be called general talk about various junction boxes, but not a single drawing to illustrate the types discussed; whilst the important matter of mechanical protection of cables is dealt with on only two pages, and illustrated by two small scale sections, one showing bricks laid over the cable longways and the other showing them broadways.

The most elaborate technical part of the book on underground lines is that on localisation of faults, and here, by the preface, we are led to expect specially valuable information; for the authors say in it that although the methods given in "some text-books" are sufficiently well known, yet their practical application under the varying and difficult condition of actual service, demand special elaboration. This is certainly true, and one turns with eager expectation to the chapter in question in order to see what the authors have to say about these special devices. Here again we are rather disappointed; although the author who has contributed this part is certainly a man who knows his subject well, and gives a series of practical and numerical examples evidently culled from his practice, one does not find much which may be considered as new methods. Our old friend the loop test crops up in various guises, and when we are told that a special wire must be run where no sound cable is available to complete the loop, the advice is, no doubt, quite serviceable, but it can hardly be considered as an advance upon the text-book method; it is simply an obvious way of carrying it out.

For the localisation of a break in the conductor a method based upon measurement of capacity is recommended. This also is old. Most engineers will expect that when a cable parts bodily the insulation at the break will also be destroyed, so that a method based on the measurement of capacity becomes inapplicable; but, curiously enough, the authors give a case from their experience where the insulation had remained perfect. The history of this breakdown, and of the expedients employed to keep the service up under a variety of great difficulties, is very interesting reading, whilst the fact that the engineers were able to locate the break within a few yards is a striking vindication of a method which at first sight seems of doubtful value. What the authors have to say about the legal

aspect of overhead lines applies to France only; but their remarks on wayleave, compensation to landowners, organisation of working parties, establishment of work-places for the manufacture of ferro-concrete masts at various parts of the line, the transport of these masts, their erection, and other matters of an administrative nature, is well worth reading, and is, with but slight modifications, also applicable to similar work when done in this country.

GISBERT KAPP.

OUR BOOK SHELF.

Facts and Fallacies regarding the Bible. By W. Woods Smyth. Pp. x+208. (London: Elliot Stock, 1911.) Price 3*s.* 6*d.* net.

MR. WOODS SMYTH aims at showing that modern scientific knowledge is in agreement with Divine revelation as recorded in the Bible. He considers that the Mosaic account of the creation of worlds and of the various forms of life up to man should be accepted as an authoritative and accurate statement of inorganic and organic evolution. "The sober truth is," he says, "that wherever the Bible touches upon questions of science it does so with a grace, an accuracy, and a philosophic perfection which surpasses every text-book of science in existence."

This position is clear enough, and we cannot but admire the author for his courage in occupying it in spite of the difficulties involved. We believe, however, that he will not find supporters among theologians who know most of the origin of the Scriptures or among philosophers who are best acquainted with the facts of nature. If all scientific knowledge and theory of to-day can be shown to be only a confirmation of the Biblical record, what will be said a hundred years hence, and what was the case in the time of early Greek philosophers? Science is progressive, and the accepted views of one generation become the discarded lumber of another.

Unless, therefore, the Bible is regarded as containing all scientific knowledge for all time, there is not much purpose in showing that science and revelation are in agreement at a particular epoch, even assuming this to be the case. A more reasonable view to take is that the Scriptures are faithful historical records of what was thought or believed when they were compiled, containing observations of obvious phenomena only, and interpretations appropriate to the period in which they were made. Any attempt to show that the facts of modern science can be confirmed by reference to an inspired literature must depend upon special pleading for its case, and can do little to further the desire "to restore the Bible to its high place of authority by restoring faith in the subject-matter of the Divine revelation."

"I Wonder" Essays for the Young People. By the writer of "Confessio Medici." Pp. 109. (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

THE young people to whom the author refers on the title-page of this book must be of a metaphysical frame of mind to be able to read these essays with interest and intelligence. The subtle reasoning occasionally involved requires careful thought for its comprehension, and is best appreciated by the adult philosopher. A fine distinction on the use of the verb "to wonder" is made in the first essay. "Make up your mind," says the author, "that you will only wonder at," and do not wonder if, is, when, or where. But the verb signifies to doubt or expect as well as to marvel; so that the advice given need not be taken literally. There is a useful lesson in the second essay, which aims at showing that many attributes of things exist only so far as our senses are able to appreciate them; but it will be lost on most young people. Other essays deal with the wonder of nature, of self, of pain, of death, of beauty, and the use of wonder.

It is scarcely correct to say that "there are gases to which the air is as paving-stones to feathers," or that the something—signifying the ether—which exists throughout space "is one and the same energy, manifest in all things." If, as the author says, "it takes a fellow of the Royal Society to think of the interstellar ether," it may be said with equal approach to accuracy that membership of the Aristotelian Society is desirable to appreciate the points of some of his essays. The book has, however, the merit of fine style and noble thought, and provides an admirable antidote to the influence of overmuch attention to materialistic affairs.

Das biologische Schullaboratorium. By Dr. W. Schoenichen. Pp. 67. (Leipzig: Quelle and Meyer, 1910.) Price 1.60 marks.

IN this pamphlet Dr. Schoenichen gives an interesting account of the structural arrangements, equipment, and course of study in the biological department at the Helmholtz "Realgymnasium" in Schöneberg. The author passes rather lightly by the courses of general zoology and botany, though there is abundant internal evidence that these subjects are accorded a generous and judicious treatment. His main purpose appears rather to be to lay stress upon the hygienic value of biological study as a subject of general education. In this country a certain hazy conception of spores, germs, bacilli, bacteria percolates through the medium of the daily Press into the mind of the man in the street, but neither he nor his wife has any real knowledge of the "why" and the "how" of personal or domestic hygiene. About half of the present treatise is more or less directly concerned with this aspect of biology, and accordingly we find full accounts of a few of the more common species of moulds, of nutrient media, and the various appliances employed in connection with them; of the process of sterilisation and the production of "pure" cultures. A prominent place and full description are given of Prof. Lindner's ingenious "roll-cylinders," and of their employment in the biological analysis of air, water, &c., and his method of "drop-culture" is well explained and illustrated.

The concluding pages are devoted to a brief survey of the biological courses at ten of the German universities.

What will the Weather Be? The Amateur Forecaster's Vade Mecum. By H. G. Busk. Pp. 27. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1911.) Price 6*d.* net.

THIS little manual is intended to enable the non-scientific reader to forecast the weather, for a day in advance, from his own observations. Tables arranged under the principal wind directions show the average conditions of weather to be expected in winter and summer, with changes of barometrical pressure. The work is accompanied by a useful introduction by Mr. H. B. Stone, explaining the usual sequence of weather in areas of high and low atmospherical pressure; it is this principle that lies behind the tables, and may enable a forecaster to obtain "reasonable accuracy" by their use. More accurate forecasting depends upon the tracks actually being taken by cyclonic disturbances and other considerations, including the configuration of the ground.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Non-simultaneity and the generally Eastward Progression of Sudden Magnetic Storms.

UNDER the above heading, Dr. L. A. Bauer contributes to NATURE of March 2 a letter of five columns. Referring to his Table II., p. 10, he says:—"It will be noticed that Kew is not included, for the simple reason that although Dr. Chree scaled the required data some months ago, he has not yet published them nor forwarded them to me"; and later he adds:—"Dr. Chree could not have done better than immediately to have published his own data in the same open manner that Mr. Faris had done. Instead, he labours to discredit the Coast and Geodetic Survey observations, and withholds his own from public scrutiny. In half the interval of time between the first and second presentation of his paper, had Dr. Chree chosen, he could have had at his command data from Europe and Asia which, combined with his own, would have served admirably to have tested the main contentions." The real facts are as follows. In July, 1910, I consulted the Kew curves for the dates of the fifteen disturbances treated by Mr. Faris and Dr. Bauer, and, as stated in the paper read before the Physical Society (Proc., vol. xxiii., part i.) on November 11, "I was able to identify ten of the fifteen disturbances with reasonable certainty." The measurements I then took were confined to the times of commencement of these ten disturbances. Dr. Bauer's request for data, which reached me in January, included, not merely the times, but the amplitudes of all the movements. I supposed, mistakenly, as it proves, that before publishing anything Dr. Bauer would await the data from the more remote stations, which could not well reach him in less than two or three months. I thus gave precedence to official work of urgency. Also, to get the best results possible, I had an independent set of measurements made by my chief assistant, and took a fresh set myself, and considered carefully all cases in which the times obtained differed by more than one minute, the limit of accuracy I hoped to attain. In a good many cases I was doubtful which of several small movements was the one intended, so curves were drawn indicating the movements and times, and amplitudes were given for the various alternatives. The results of this very considerable labour were dispatched to Dr. Bauer on February 25, no hint having meantime been received from him that the data were urgently wanted.

The charge that I laboured to discredit the Geodetic Survey observations is equally unjustifiable. As anyone who reads my paper will readily recognise, my criticisms were directed, not against the observational data—which, I may say, struck me as quite up to the usual standard of observations—but against the use made of them. In bringing forward these criticisms, I hoped to do better service than by collecting a number of other miscellaneous data, affected by similar uncertainties, the course which Dr. Bauer thinks it was my duty to adopt.

As Dr. Bauer takes no notice of my criticisms, I should like to indicate briefly their nature, to assist the comprehension of your readers.

Mr. Faris deduced times of commencement and corresponding velocities of propagation from Horizontal Force (H), Declination (D), and Vertical Force (V) curves separately. On the average, the H times preceded the D by 0·44 and the V by 2·3 *minutes*. I indicated the improbability of the disturbing force commencing with a component along one only of the three fundamental directions at a station. Normally, one must expect components in all three directions; thus systematic differences in the times of occurrence in the D, H, and V curves can hardly be real. To be visible, a disturbance must attain a certain amplitude. So-called "sudden commencements" really take several minutes, as a rule, to reach their maximum, and the apparent differences in time mean, presumably, differences in the amplitudes of the three components, or difference of sensitiveness in the three magnetographs. The neglect of this point of view may lead to serious error. To see this, take a simple case. Suppose a number of similar compasses to be placed on a straight line radiating out from an electromagnet. Suppose each needle frictionless, but its displacement imperceptible until it attains 1′. Let, now, a slowly increasing current actuate the electromagnet. As the current rises, movements become visible in one compass after another, and an unscientific observer might infer that a disturbance was being propagated outwards from the magnet with a velocity which might be very small if the current increased very slowly. The time, however, when any compass is visibly affected is determined, not by the velocity of propagation of electromagnetic waves, but by the sensitiveness of the needle, its orientation, and the rate of increase of the current actuating the electromagnet. Disturbances of the type selected by Mr. Faris are usually largest in H and least in V, and it thus appeared to me highly suggestive that the times derived from the H curves were so markedly the earlier. The tendency in all cases must be for the time shown to be late, the error being greater the smaller the disturbance and the less sensitive the magnet. If, then, on any given occasion, a disturbance nowhere large were smaller in Europe than America, we should expect the time of commencement shown by the average European magnetograph to be a little behind that shown by the average American instrument.

Another criticism I made was this. Originally—so far as I could understand—Dr. Bauer and Mr. Faris assumed differences in times at any two stations to depend only on differences of longitude. This implied that the disturbance travelled either due east or due west, appearing simultaneously at all places in the same longitude. Five American stations were arranged in two groups, the mean longitudes (79° 9′ W. and 146° 42′ W.) of these being regarded as belonging to two central stations 68° apart. Call these two imaginary stations A and B, the former being the nearer to Greenwich. It was recognised by Mr. Faris that a disturbance travelling, say, westwards, might pass A first, reaching B after travelling 68°, or it might pass B first, reaching A after a journey of 292°. In the former case it originated in the wide zone, 267°, separating the extreme stations Honolulu (158° W.) and Porto Rico (65° W.); in the latter case it originated in the narrow zone, 40°, separating Baldwin (95° W.) from Sitka (135° W.). The peculiarity I dwelt on was that no fewer than nine out of the fifteen disturbances were treated as if originating in the narrow zone, whereas one would have expected only two or three. Dr. Bauer does not refer to this point, but the method he now follows seems different. He again takes two central stations, this time one in America, the other in Europe, but he determines the velocity, apparently, not from the difference of longitude, but from the arc 75° on the connecting great circle. Further, he tacitly assumes that all the disturbances commence in the wide zone between the westmost American and eastmost European station, as all are assumed to traverse the 75° arc and none the 285° arc. This may or may not be a better plan than that first adopted, but it is totally different. A hypothesis which makes all the fifteen storms originate between Honolulu and Katharinenburg is obviously incompatible with one that makes nine out of the fifteen originate between Baldwin and Sitka.

Dr. Bauer's second method would avoid the difficulty I pointed out of supposing that the velocity near the poles is not merely moderate, but actually small. It has, however, this obvious drawback, that it cannot give a true velocity at all unless we suppose the disturbances to actually travel along one particular great circle connecting two arbitrary points on the earth's surface.

One of my criticisms related to inconsistencies between the times shown by different stations and the conclusions reached as to the direction and velocity of propagation. This can be better illustrated by some data used more recently by Dr. Bauer himself (*Terrestrial Magnetism*, December, 1910, Table IV., p. 225), which are much more open to criticism than those from the Coast and Geodetic stations. He takes seventeen disturbances given by Mr. Ellis as recorded at eight stations between 1882–9. Dr. Bauer forms two groups of these stations, the second

containing Bombay, Batavia (107° E.), Zikawei (121° E.), and Melbourne (145° E.). Omitting hours, here are the times in minutes assigned for the commencements at the three last-mentioned stations:—

37·0, 39·7, 8·7, 48·7, 52·7, 42·7, 20·7, 44·0, 4·7, 48·7, 46·7, 18·7, 54·7, 32·7, 24·7, 45·7, 52·7,

31·3, 32·3, 0·3, 45·3, 46·0, 35·6, 21·3, 38·3, −1·2, 41·8, 41·0, 15·3, 50·3, 27·3, 20·8, 41·3, 47·4,

38·4, 33·4, 5·1, 50·0, 55·1, 45·1, 25·1, 45·1, 0·1, 55·1, 45·1, 15·1, 50·1, 35·1, 25·1, 45·1, 45·1,

The number of 7's in the first and second lines, of 3's in the third and fourth, and 1's in the fifth and sixth, tell a tale to anyone who has eyes. It is the treatment of the data, however, to which I would direct attention. Zikawei, though intermediate in longitude, differs usually in the same direction, as regards time of commencement, from Batavia and Melbourne. Its time is earlier than that of Batavia in sixteen cases, and than that of Melbourne in fourteen cases, out of seventeen; and the mean algebraic difference is no less than 5·2 *minutes* in the one instance and 4·6 in the other. Instead of recognising that data such as these are useless for any purposes of high accuracy, Dr. Bauer gets out means from his two central stations and obtains an average of between three and four minutes for the time of going completely round the earth, a time markedly less than the data employed give between Batavia and Zikawei, stations differing by less than 15° in longitude or 38° in latitude.

A final criticism I might mention is this: If disturbances travel round the earth in the way Dr. Bauer supposes, why do not they quite complete the circuit, or even go round several times? In some cases, at least, the amplitudes of commencing movements at stations nearly 180° apart are very similar, so that going half-way round can have had but little effect, and movements with a much reduced amplitude would still have been conspicuous. Earthquake tremors, we know, do go round more than once.

As regards the theory vaguely outlined by Dr. Bauer (pp. 10–11), I am not surprised by his claim that "the careful reader will not fail to observe that . . . [it] is considerably different from that which Dr. Chree imputed to me." But unless I had had prophetic powers, how could it have been otherwise? The earlier theory reached or was based on a definite mathematical equation (*Terrestrial Magnetism*, June, 1910, p. 123), $v = XneD/p$, where v is "the velocity of the moving ions . . . n the number of molecules in a c.c. of gas at a pressure p dynes per sq. cm., e the electric charge carried by an ion, D the coefficient of diffusion of an ion through the gas." Of X Dr. Bauer tells us:—"Regarding the variation of X, some preliminary calculations would appear to indicate that the potential gradient of 1 volt per cm. assumed may be of about the right order of magnitude for the heights concerned" (75 km. is the height finally suggested). My primary difficulties were two. Sir J. J. Thomson, the authority quoted by Dr. Bauer, applies the formula to ions moving in the direction of the field X. Dr. Bauer makes v a horizontal velocity; but "potential gradient" is a term usually applied to the earth's *vertical* field, and 100 volts per metre is the value usually ascribed to it, as an average (probably a low one), at ground-level. Potential gradient, in the usual sense of the term, is known from balloon observations to fall to one-tenth of its ground-level value at heights of a few thousand feet, and at 75 km. it is usually supposed to be infinitesimal. If by "potential gradient" Dr. Bauer means a horizontal field, he should say so explicitly, and explain how it is produced and how he reaches his numerical estimate. As regards his concluding remark on the question of theory, "If Dr. Chree has something better to offer I shall be glad to know it," I labour under the disadvantage of holding the view—antiquated though it may appear to some of my contemporaries—that before advancing a mathematical theory for any supposed phenomenon, it is desirable to make reasonably sure that the phenomenon actually exists.

If we take Dr. Bauer's latest conclusions respecting the fifteen storms he deals with in NATURE, we have nine going east and six west. The mean algebraic difference between the European and American times of commencement, + denoting earlier occurrence in America, is only +0·11 minute. In view of the fact mentioned by Dr. Bauer that the algebraic mean difference between the times deduced by two skilled observers, Drs. Venske and Krogness, for the commencements of six disturbances at Potsdam—one of the best equipped of stations—was no less than 0·4 minute, I think most physicists of experience will recognise the expediency of awaiting something much more decisive before passing a final judgment.

March 4. C. CHREE.

TOGETHER with Mr. O. Krogness, I am just on the way to Khartoum, in Sudan, in order to carry out some researches on the zodiacal light.

In connection with these investigations, we propose to secure some magnetic records with very sensitive apparatus. Special care will be taken to obtain as accurate a time-determination as possible.

For one set of observations we shall use an hour-length of 20 mm.; for another set, with twelve times greater hour-length, records will be obtained between about 5h. p.m. and 3h. a.m. Greenwich mean time.

If at other observatories, especially near the equator, similar *rapid* records could be secured *in the same time-interval*, these would, I think, be of value in deciding the question of the simultaneity or non-simultaneity of abruptly-beginning storms.

Our records are intended to commence on March 20, and will continue for one month.

Similar records will also be obtained by Prof. S. Saeland in Trondhjem. KR. BIRKELAND.

Berlin, March 3.

The Centenary of Bunsen's Birth.

ON March 31 it will be one hundred years since Robert William Bunsen was born, and it has been felt that that occasion should not be allowed to pass without his pupils and admirers in this country giving expression to their veneration of the memory of one of the greatest chemists of our times. A committee has been formed to make the necessary arrangements, and it was intended to celebrate the centenary by a dinner. Unfortunately, the two most distinguished pupils of Bunsen, Sir Henry Roscoe and Sir Edward Thorpe, are at present prevented by indisposition from attending such a celebration. In these circumstances the committee has decided not to proceed with the arrangements for a dinner; but, feeling that the occasion should not be allowed to pass unnoticed, they have resolved to send a signed address to the Heidelberg University from old Heidelberg students in this country, and to place a wreath on the Bunsen monument. May we request those old Heidelberg students who wish to participate in this movement to send their signatures to Prof. H. B. Dixon, of the Manchester University, the chairman of the committee, or to either of the undersigned honorary secretaries?

FRANCIS JONES (Manchester Grammar School).
J. GROSSMANN (Plymouth Grove, Manchester).

Chemical Laboratory, 157 Plymouth Grove,
Manchester, March 11.

Life and Habit.

YOUR correspondent "W. H. M." (NATURE, March 2, p. 12), who believes that it is necessary for newly hatched chicks to learn to eat by imitation, should see a litter of pigs being born. Each little pig the moment that he is outside hurries over the sow's hind legs, and, in the second second of his outdoor life, has a teat in his mouth. If the navel-cord has not got clear of his late home, he tugs away at it with all his might. Seeing such a sight, one might suppose that before birth the creature had been eagerly looking forward to his first breakfast. Or did the splendid prospect flash into his mind only as he found his feet? FRANCIS RAM.

54 St. John's Road, N., March 13.

BIG-GAME SHOOTING IN PATAGONIA AND NEWFOUNDLAND.[1]

"IN Patagonia no one uses the word 'mile,' the distances are so great that all reckoning is counted in leagues," writes Mr. Prichard in his remarkably interesting studies of these desolate, extra-tropical pampas of South America. He contrasts this measurement with what prevails in vast Canada, where the land is so good and so usable that the distances are computed by the acre. "In sterile Patagonia, no farmer can make a living on less than fifteen square miles." In this region he pursued the wild guanaco, belonging, as he does still, to the old school, which thinks it better sport to kill than to photograph. He also shot the guemal, or Patagonian deer—*Cariacus* or *Mazama bisulca*. (The reviewer wishes that some zoologist of commanding physique and authority would settle, as with a hammer or an axe, what is to be the universally accepted generic name or names of this group of American deer.) We are probably still without adequate and correct information regarding the species and varieties of South American deer, and even the size to which some of them attain and the fullest developed type of antler. Mr. Prichard estimates that the Chilian (Patagonian) guemal stands from 36 to 38 inches at the shoulder and weighs about 160 lbs. He states that the specimens of horns in the British Museum are poor. The antlers given in the painted illustrations seem slightly more developed than those in the photographs of the specimens obtained by Mr. Prichard himself, though these are of distinct interest, and perhaps, as he says, much better than anything in the national collection.

The guemal, according to Mr. Prichard, does not range eastwards far from the foothills of the Andes; it is practically absent from the flat, grassy plains of Patagonia.

Besides this deer and the guanaco, Mr. Prichard shot rheas, swans, geese, ibis, condor, Magellan wolves, and saw several fine specimens of puma. He records how this "poor-spirited cat" is frequently tamed and kept as a pet until almost full-grown. One settler near Lake Argentine lived alone in a single-roomed hut throughout the winter with two three-quarter-grown pumas.

As to the Amerindian natives of this region, the Tehuelche, he describes them as a fine race, with large, well-hewn features, their skin of a reddish-brown. But although they average six feet in stature, they have notably deteriorated in physique, from their habit of riding on all occasions and everywhere. A man will not walk a hundred yards, but catches his

The Heads of Canadian and Norwegian Elk contrasted (the lower head is Scandinavian). From "Hunting Camps in Wood and Wilderness."

[1] "Hunting Camps in Wood and Wilderness." By H. Hesketh Prichard. With a Foreword by F. C. Selous. Pp. xiv+274. (London: W. Heinemann, 1910.) Price 10s. net.

horse and rides the distance. So far as the upper part of the body is concerned, the breadth of shoulder and great back and arm muscles demand admiration, but the lower limbs are not proportionately strong.

From the Andes and treeless plains of Patagonia Mr. Prichard whisks the reader to the wildest parts of Labrador and of Newfoundland. After that we have a digression dealing with moose (elk) hunting in Norway, distinctly interesting by the juxtaposition of the scenery, flora and fauna of that country with the north-eastern parts of British North America. Mr. Prichard attempts to show by his illustrations and explanations—or leads us to infer—that a specific difference exists between the elk of northern Europe and the elk of North America, which is cited as *Alces americanus*. But we fancy that zoologists do not claim a full specific difference between these creatures, widely as their habitats are separated at the present day. If the reviewer's memory is correct, Mr. Lydekker himself only claims for the very marked variety of elk in north-eastern Asia the position of a subspecies, *Alces machlis bedfordiae*; and there is distinctly less difference in antlers and other features between the elk of North America and that of Scandinavia, except that no doubt during the last hundred years or so the antlers of the last-named have degenerated, owing to the persecution of the species at the hands of the hunters. Nevertheless, the present difference in size between the Canadian and Norwegian elks is well illustrated by the photographs here reproduced.

Very interesting, and in some respects novel, information is given about the Canadian elk. Mr. Prichard, quoting other authors, touches on the discovery of the gigantic subspecies of elk in that country of marvels, Alaska, the home of the biggest existing bear, the biggest wild dog or wolf (*Canis pambasileus*), and of the biggest elk (*A. m. gigas*), a monster with palmated antlers measuring 76 inches in contradistinction to the 40 inches of an exceptionally good head in Norway, and the average 50 inches of Canada.

Some splendid heads of caribou (Canadian reindeer) were secured by Mr. Prichard and his companion, Mr. Gathorne Hardy. Admirable photographic illustrations are supplied to illustrate the scenery of Newfoundland, a country still all too little known to adventurous travellers seeking for varied phases of landscape beauty. We are made to realise the desolateness of Labrador and yet the charms of its solitude.

"A little lake . . . lay some two miles to the north-west of our camp. Surrounded by trees and seemingly of great depth, it presented the appearance of an unfathomable pit sunk into the roots of the hills. The diver and her brood called ceaselessly upon its waters, bringing back to memory the beautiful and poetic words of Saltatha, the Yellowknife Indian: 'You say the Kingdom of Heaven is good, my father, but tell me, is it better than the land of the musk-ox in summer, when the lakes are sometimes misty and sometimes blue, and the loons cry often? That is good, my father, and if Heaven is better, I shall be willing to dwell there until I am very, very old.' Besides the loon two ospreys haunted the lake, sometimes fishing in the shallow stream which fed it, sometimes winging their way over it and out into the blue distance towards the sea."

Elsewhere in the book there are pen portraits, unconsciously given, of the different guides, hunters, and trackers associated with Mr. Prichard or his companions, some of Newfoundland, some of Labrador, and one or two of Maine (United States) origin. In every case, these simple, virile, honest natures are brought home to us with their quaint diction, shrewd faces, and slovenly clothing, and we realise what good stuff there must be in the manhood of North America. The Mikmak Indians of Newfoundland (recent comers and settlers from the adjoining coasts of Cape Breton and Nova Scotia) are also illustrated verbally and by photography. Mr. Prichard justly points out that it is sentimental nonsense allowing Indians greater privileges in the way of game destruction than are accorded to white men. All alike are citizens of British North America, enjoying the same privileges and subject to the same laws, and it would be no satisfaction to the zoologists of the next generation to be told that the big game was destroyed in Newfoundland by Indians and not by white men.

Altogether this is one of the most attractive and informative works on the big game of the New World which the present reviewer has had the pleasure of reading. The coloured illustrations by Mr. E. G. Caldwell are of remarkable excellence, worthy of Mr. J. G. Millais. Besides being beautiful pictures, they are absolutely truthful, not only in the delineation of beasts, but in the botany of the background. Two of Lady Helen Graham's drawings also deserve special mention; one, of a scene in the Patagonian Andes with guemal deer in the foreground, and another, a study of a bull elk being surprised at night by the light of a lantern.

H. H. JOHNSTON.

THE FANCY FEATHER TRADE.[1]

IN NATURE for December 15, 1910, we reviewed "Aigrettes and Bird-skins," a book written in defence of the bird-plume dealers, in which the name of Mr. C. F. Downham was cited frequently as a witness for the "defendants." This gentleman now appears before us as further counsel on the same side in an address under the second title of "Some Facts and Fallacies in Connection with the Trade in Fancy Feathers," delivered before the London Chamber of Commerce in November last. Part of it has been published as an article in the *National Review*; "The Feather Trade: The Case for the Defence," is an amplified edition. In the number of NATURE just referred to—which may be read in connection with the present observations—we strongly expressed our disagreement with the arguments then put forward. Our view we find independently supported by the *Madras Mail* of September last, which says that "'Aigrettes and Bird-skins' will evoke little sympathy in India. Indeed, it would more probably be read with feelings of derision and ridicule on account of its erroneous and fallacious arguments were its subject not so pathetic."

These words seem to us to sum up very tersely the further defence made by Mr. Downham, who, as managing director of one of the plume-importing firms, can hardly be considered an entirely disinterested advocate. In years past the defence set up by the trade was that the "aigrettes" were artificial, and all the plumassiers' saleswomen were directed to inform tender-hearted buyers that this was really so. Ornithologists were able, however, to nail this deception to the counter so effectually that it had to be abandoned. In its stead arises now the equally spurious statements that they are taken out of the nests, where they form a bed for the eggs; and that in vast heronries in S. America, in Venezeula in particular—whence the largest export comes—

[1] "Some Facts and Fallacies in Connection with the Trade in Fancy Feathers." A Paper read at the London Chamber of Commerce in November, 1910, by C. F. Downham. Pp. 126. (London Chamber of Commerce, Oxford Court, Cannon Street.) Price 6*d*. net.
"The Pros and Cons of the Plumage Bill." A Letter. By James Buckland, of the Royal Colonial Institute.

egrets and other birds are being protected, and that thence, "as for many years it has been known in the trade, a great part of the supply is obtained by collecting the feathers naturally shed by the birds . . . the *opinion* [the italics are the reviewer's] of those in the trade is that considerably more than two-thirds of the supply is so obtained."

These statements are attested by three witnesses: M. F. Geay (now dead); M. Leon Laglaize, who, in being, as it appears, a buyer for a firm of dealers, is scarcely as unprejudiced a witness as might be desired; and M. Grisol. Against their testimony must be set that sent to the Royal Society for the Protection of Birds by H.M. Minister at Caracas (dated January, 1909), who emphatically asserts that M. Laglaize "gives a completely erroneous impression of the conditions under which the industry of collecting plumes is conducted in Venezuela"; of the Consul at Rosario, and of various scientific men, among them, Mr. Quelch (a well-known naturalist, formerly on the staff of the British Museum), who describes the hideously cruel manner of taking the plumes, and declares that "during a residence of seventeen years in British Guiana . . . I have never known or heard of any such method of collection as that described by M. Laglaize"; of Mr. Dresser, author of "The Birds of Europe"; and of Mr. F. Chapman, the distinguished ornithologist of the American Museum of Natural History in New York. These witnesses are convinced that the "moulted plume" theory is as fallacious as the "artificial aigrette" defence, and ornithologists know that egrets do not line their nests with their own nuptial plumes.

It is significant that the collectors' busy time in the swamps is the height of the breeding season. The egrets assume their nuptial plumes before that period begins in August, and shed them only about October, till when there can be few—if any—plumes on the ground to gather. It is well known also that by that date the "aigrettes" have, by reason of wear and tear, become of little or no commercial value.

We find it stated by Mr. Downham that the fancy feather trade has its mainstay in poulterers' refuse and plumes of game birds killed for food; and then by the traders' own testimony, Are not the "aigrettes" wholly artificial? Why all this great outcry that their entire business is in peril should an Act be passed against the import of our finer plumaged bird-skins? The true egret imports can consequently have only a negligible influence on their market. It has been obvious to everyone that during the past year feathers have been worn in women's hats in greater profusion than ever, and that few of them have been those of game or barn-door fowls. Lyre-bird, Argus and Himalayan pheasant, flamingo, peacock, robin, jay, kingfisher, goldfinch, trogon, bird of paradise, and goura pigeon have come under the writer's own notice. Some hats, indeed, were entirely composed of British bird-skins. From Venezeula alone in 1908, 255,900 egrets were exported, and necessarily a large proportion of the offspring of these birds was sacrificed.

Mr. Downham's pamphlet contains short notes on the best-known species of paradise birds by Mr. A. E. Pratt, about which we may be allowed a word from an ornithologist's point of view. It would be interesting to have the evidence—no doubt in his possession—for the statements he makes that these birds are three years old before they produce marketable plumes, and that the Aru islanders watch over the *Paradisea apoda* until they have attained that age. We should hesitate to accept as a fact, without very strong evidence, that the Papuan will stay his hand against any living creature he wants when his opportunity occurs, in hope of some other day meeting it in better condition, and with the chance that his neighbour will forestall him. The fact that the collections of birds by native hunters contain mature and immature skins in equal abundance militates strongly against such a belief.

Our observations upon the Fancy Feather trade were already written before the Pros and Cons of the Plumage Bill reached our hands. All who are doubtful as to their support of this Bill should read Mr. James Buckland's pamphlet. The cruelty of the plumage collector's methods and the enormity of their slaughterings as here set out will appal the reader. He substantiates with exact chapter and verse the precise manner in which the Indian Plumage Bill is systematically evaded by the native plume collectors, because the import of feathers into London is so free and unprohibited. Mr. Downham, in his Case for the Defence, attempted to impune Mr. Buckland's statement made in 1909 that 1,500,000 egrets had been slaughtered in 1908 in Venezuela alone, by asserting that the customs export returns at Ciudad Bolivar were untrustworthy on the point. The British Minister, however, corroborates fully Mr. Buckland, and cuts from beneath them one more of the doubtful testimony of the plume traders, by stating in his report for that year:—"This [the destruction of egrets] is really appalling. . . . If, therefore, we take the average, the number of birds killed last year was 1,538,738; but if we take the highest number it was 2,469,930, and even the lowest accounts for the slaughter of 610,385." Mr. Downham also denies that egret feathers come from Australia. If this be so *now*, it must be because the heronries have been shot out. Mr. Buckland is able to adduce an eye-witness in Mr. Mattingley, the Australian ornithologist, to the methods practised by the Commonwealth gunners, in every respect similar in cruelty and ruthlessness to those of their brethren in Venezuela and elsewhere. Above we have thrown doubt upon the statements of Mr. Laglaize, adduced by Mr. Downham, as to the protection of the heronries in Venezuela and to the collecting of the plumes from the nests. Mr. Buckland goes so far as to assert that, "For sheer power and majesty of lying these statements excel anything ever achieved by Ananias, even at his best."

Mr. Buckland gives equally appalling details as to the destruction of gulls, terns, herons, grebes, pelicans, swans, geese, ducks, ibises, birds of paradise, goura pigeons, and humming-birds, in every region of the globe. "Great heaps, waist high, of dead *Diomedea immutabilis*, and of the black-footed albatross"; "On Marcus Island a party had wiped out of existence one of the largest albatross colonies in the Pacific," are a couple of extracts from him as to the operations of those who labour for the adornment of English ladies. Mr. Buckland's pamphlet supports also our doubt, expressed above, as to the Papuan hesitating to spare any bird he comes across, because it is immature.

It is abundantly evident, therefore, that the testimony, sworn statements, and various excuses brought forward in their attempts to represent this nefarious trade as a pure and legitimate industry, by the textile trade section of the London Chamber of Commerce, are sadly wanting, both in cogency and in veracity.

These latest attempts will, we trust, fail, like the others they have set up, to delay the Plumage Bill, introduced in the House of Commons on February 22, from becoming law "at the earliest possible opportunity," as *The Times* of November 26, 1910, so strongly urges, "which can be found in the new Parliament for business of an uncontentious character."

THE BLACKFEET OF MONTANA.[1]

THE Piegan Blackfeet of Montana are one of the most interesting of the tribes classed as Plains Indians, and it was well worth the while of Mr. Walter McClintock to spend many summers in living among them in order to study and record their customs and religion. The worthiness of his intention and his personal character so appealed to Mad Wolf—one of the prominent men of the tribe—that he adopted Mr. McClintock as his son, hoping for an alliance with a white man that would be productive of sympathy, and fidelity to the welfare of his tribe, and who, by being familiar with their customs, religion, and manner of life, would tell the truth about them to the white race. The present book is a justification of Mad Wolf's action.

FIG. 1.—A Woman Praying to the Sun. From "The Old North Trail."

Mr. McClintock has not written a formal treatise on the Blackfeet, and much that students would like to learn about them has been omitted. A book that would satisfy specialists would not appeal to the public, and doubtless the object of Mad Wolf will be better attained by the narrative form in which the book is cast. The descriptions of climate and scenery, of hunting experiences, and the daily life of an Indian camp give a live and accurate impression, not only of the present condition of the Indians, but enable the reader to gain some idea of what that life was like in the past, when immense herds of antelope and bison roamed over the plains and when the Blackfeet warriors traversed wide tracts of country in quest of plunder and adventure. The old men remember the days of their pride, but soon the memory of them will pass away and meagre records will alone be available in the books of such writers as Catlin, Mackenzie, Grinnell, and McClintock.

Several ceremonies are described, that of the "Beaver Medicine" being illustrated with numerous photographs showing various phases of the ceremony; as these were taken under adverse circumstances in a tipi, they are not so clear as the majority of the illustrations. Most readers will probably be astonished at the number of prayers that are said at these ceremonies, and Mr. McClintock deserves our thanks for having recorded so many of the prayers and chants. It is mainly by having the actual words that we can get a true insight into a ceremony, but, in addition, it is necessary to have a ceremony recorded by a sympathetic observer like the author, for it is quite possible to record every action and yet miss the spirit of a ceremony, as has too frequently been the case. Even at the present day the older Indians are extremely devout and spiritually-minded; this religious attitude of mind combined with a sense of dignity and personal worth are perhaps the most prominent characteristics of the Indian. The present writer has seen a Pawnee and a Blackfeet sacred bundle opened, and he quite endorses Mr. McClintock's statement that "It is difficult for one of the white race to realise the deep solemnity with which the Indians opened the sacred bundle. To them it was a moment of deepest reverence and religious feeling."

The Blackfeet are firm believers in the supernatural and in the control of human affairs by both good and evil powers in the invisible world. The great spirit, or great mystery, or good power, is everywhere and in everything—mountains, plains, winds, waters, trees, and animals. They believe that all animals receive their endowment of power from the sun, differing in degree, but the same in kind as that received by man and all things animate and inanimate. Some, such as the grizzly bear, bison, beaver, wolf, eagle, and raven, are worshipped because they possess a larger amount of the good power than the others, and so, when a Blackfoot is in trouble or peril, he naturally prays to them for assistance. The sun, as the great centre of power and the upholder of all things, was the Blackfeet's supreme object of worship. He saw that every bud, leaf, and blossom turned its face to the sun, that the berries ripened under its warmth, that men and animals thrived under its sustaining

FIG. 2.—Tribal Camp of the Blackfeet. From "The Old North Trail."

[1] "The Old North Trail," or Life, Legends, and Religion of the Blackfeet Indians. By W. McClintock. Pp. xxvi+539. (London: Macmillan and Co., Ltd., 1910.) Price 15s. net.

light, but all perished when it was withdrawn. The devout Blackfoot therefore called upon men, women, and children, and everything that had breath to worship the all-glorious, all-powerful sun-god who fills the heaven with brightness and the earth with life and beauty. The sun-dance was their great annual religious festival, their holy sacrament, the supreme expression of their religion. It must always have its beginning in a woman's vow, made to the sun-god for the recovery of the sick. The account given of the sun-dance is of interest, but far too short for the student.

Various legends and stories are given, and the occasions on which they were told are given, so the tales fit naturally into the pictures of Indian life that Mr. McClintock presents. This is a book that should be read by all who are interested in the ways and thoughts of alien folk, and its value is increased by the very numerous and excellent photographs taken by the author. A. C. HADDON.

PROF. J. H. VAN 'T HOFF.

IT is with the deepest regret that we record the death of Prof. J. H. van 't Hoff, which occurred on March 1, at Steglitz, near Berlin. It was known that his health has not been good for the last two or three years, but the unexpected news of his death at the comparatively early age of fifty-eight years will come as a very heavy blow to the world of science. For a generation the name of van 't Hoff has been familiar to students of science in every part of the civilised world. It would be difficult indeed to mention any branch of modern scientific inquiry which has not been advanced by his fundamental discoveries. Certainly physiology, biology, and geology, as well as every branch of chemistry, owe a deep and undying debt of gratitude to the genius of van 't Hoff. The memory of his name and the influence of his work will outlive the centuries, an integral part of the incorruptible heritage of science.

Jacobus Henricus van 't Hoff was born in Rotterdam on August 30, 1852, his father being a physician of that city. In 1869 he proceeded to the Polytechnikum at Delft, passing through the usual three years' technological course in two years. He was then admitted to the University of Leyden, where he studied until 1872. He continued his studies in Bonn under Kekulé, and in Paris under Wurtz. In 1874, as a pupil of Mulder, he obtained the doctor's degree of the University of Utrecht, with a thesis on cyanacetic and malonic acids.

Van 't Hoff began his teaching career in 1876 as a docent in physics at the Veterinary School at Utrecht. In 1877 he went to Amsterdam, and in the following year was appointed professor of chemistry at the University of Amsterdam. Here he remained for eighteen years.. In 1896 he was called to Berlin as a member of the Imperial Academy of Sciences and as a professor of the University of Berlin. He gave lectures on physical chemistry at the university, but a research laboratory was provided for him by the Academy of Sciences. In this position van 't Hoff continued to work until his death.

Such is a very brief account of the various positions he held during his lifetime. Needless to say, universities, scientific societies, and academies throughout the world vied with each other in honouring him. In 1888 he was elected a foreign member of the Chemical Society of London. He became a foreign member of the Royal Society in 1897, whilst the Physical Society of London elected him a foreign member this year. Amongst others, the universities of Cambridge, Chicago, Heidelberg, Manchester, Greifswald, and Utrecht conferred honorary degrees upon him. The Kaiser bestowed on him the high distinction of the Order "Pour le Mérite." In 1901 the Nobel Prize was awarded to him. Many other honours and distinctions might be mentioned, but enough has been said to show the high esteem in which van 't Hoff was held throughout the world. Like all great men of science, the true story of his life is, however, to be found in his researches.

Under the influence of Kekulé, Wurtz, and Mulder, the earliest work of van 't Hoff relates to organic chemistry. But here his genius soon enabled him to strike a note of extraordinary originality. While still engaged with Mulder in synthetic organic work, he published in 1874 a short pamphlet in Dutch, in which he unfolded his new ideas concerning the extension of organic structural formulæ to three-dimensional space, and the relation between optical activity and the presence of an "asymmetric" carbon atom. In 1875 this appeared in an enlarged form under the title "La Chimie dans l'espace," a German edition, with a preface by J. Wislicenus, appearing in 1877 ("Die Lagerung der Atome im Raume"). Thus was born van 't Hoff's famous theory of the "tetrahedral" carbon atom and the science of stereochemistry. As all the world now knows, van 't Hoff's new ideas found many opponents. In particular Kolbe, who was an opponent of structural chemical formulæ in general, attacked the new ideas and their author with great virulence. But the "lame Pegasus" which the young lecturer at the Utrecht Veterinary School had bestridden was not so lame as Kolbe imagined, and van 't Hoff's ideas gradually triumphed. The warm support of Johann Wislicenus and the work of himself and his school greatly contributed towards the recognition and development of van 't Hoff's ideas.

Not long after the appearance of the "Chimie dans l'espace," van 't Hoff published a very remarkable and little-known book, entitled "Ansichten über die organische Chemie." In it he sought to give the whole of organic chemistry a strict and logical arrangement, wherein both old and new facts should find their proper place. At the same time he emphasised the necessity for a *quantitative* study of the course of chemical reactions, and developed the fundamental equations of chemical kinetics and equilibrium on the basis of the law of man-action. Although in some respects van 't Hoff was preceded here by Guldberg and Waage, as well as by Harcourt and Esson, we perceive here the beginning of that long and masterly series of experimental and theoretical researches, whereby van 't Hoff raised the whole subject of chemical dynamics to the level of an exact and well-ordered branch of science. In the celebrated and now classical "Etudes de Dynamique chimique" (1884), van 't Hoff gave a collected account of these researches. Here is to be found a systematic study of the velocity of reactions, *as dependent on the number of reacting molecules*, a method for determining the number of reacting molecules from the experimental data, an exhaustive study of the "disturbing" actions, and an investigation of the influence of temperature on velocity of reaction. Masterly as was the treatment of chemical kinetics here set forth by van 't Hoff, one would err grievously in imagining the "Etudes" to contain nothing else. Nearly one-half of the monograph was devoted to chemical equilibrium and affinity. In this portion van 't Hoff abandoned the purely molecular-kinetic standpoint, treating the subject from the point of view of thermodynamics. One finds here the classical treatment of the equilibrium of "condensed" phases, and of the influence of temperature and pressure thereon. Here is also to be found the enunciation of van 't Hoff's

famous "Principle of Mobile Equilibrium":—"Tout équilibre entre deux états différents de la matière (systèmes) se déplace par un abaissement de la température du côté de celui des deux systèmes, dont la formation développe de la chaleur."

Finally, in the chapter on affinity, perhaps the most remarkable and original part of the whole book, van 't Hoff shows for the first time how the chemical forces operative in reaction can be measured and compared.

But van 't Hoff's greatest triumph was still to come, though we may regard the application of thermodynamics to chemical equilibrium to be found in the "Études" as preparing the way for it. In 1886 van 't Hoff's famous paper on "The Laws of Chemical Equilibrium in the Dilute, Gaseous or Dissolved State of Matter" was published in the Transactions of the Swedish Academy of Sciences. This was quickly followed by two other fundamental papers, one on "A General Property of Dilute Matter," and one on "Electrical Conditions of Chemical Equilibrium." In 1887 there appeared in the first volume of the "Zeitschrift für physikalische Chemie" an abstract of the above, bearing the title "Die Rolle des osmotischen Draches in der Analogie zwischen Lösungen und Gasen."

It would be impossible to exaggerate the fundamental importance of these researches. By developing the idea of osmotic pressure on the basis of the experimental work of Traube and Pfeffer and by an application of the laws of thermodynamics, van 't Hoff was enabled to put the whole subject of physical and chemical equilibrium in dilute solutions on a sure and simple basis. The extraordinary analogy which he discovered, and showed also to be thermodynamically necessary, between the laws connecting the osmotic pressure, molecular concentration, and temperature of a dilute solution and the corresponding simple gas laws, played a profound part in this development.

Although the laws of equilibrium in solutions had been given by Gibbs previously in a generalised thermodynamical form, and had been applied by Helmholtz to cases where the partial vapour-pressures as functions of the concentration were empirically known, van 't Hoff was the first, by means of the concept of osmotic pressure and the simple laws relating to it, to create a practically useful thermodynamical theory of dilute solutions. In doing this he demonstrated the insufficiency of Guldberg and Waage's laws in its original form, and paved the way for the electrolytic dissociation theory of Arrhenius and its development and application by Ostwald and Nernst. In fact, the simple interpretation which the theory of electrolytic dissociation gives to the coefficient i of van 't Hoff's thermodynamical equations remains to-day, as it was twenty years ago, one of the chief foundations of this theory.

The theory of dilute solutions, as developed by van 't Hoff, rendered inestimable service to the general development of chemical science in the sure thermodynamical basis which it gave to the previously empirical methods for determining the molecular weights of dissolved substances. It would be difficult indeed at the present day to discover any branch of chemical, physiological, or biological science which does not owe something to the fundamental advances made by van 't Hoff in the theory of physical and chemical equilibrium in dilute solutions.

The last great period of van 't Hoff's scientific activity was mainly devoted to a study of heterogeneous equilibrium, especially as regards the conditions determining the formation and decomposition of double salts, and the crystallisation of complex mixtures. The first fruits of these researches appeared in collected form in his "Vorlesungen über Bildung und Spaltung von Doppelsalzen" (Berlin, 1897). Here for the first time were set forth in lucid and masterly manner all the conditions of temperature and concentration which determine the crystallisation of double and single salts, with many and varied applications to special cases, culminating in the unravelling of the complicated phenomena presented by the double racemates of Scacchi and Wyrouboff. Another striking case was the working out of the conditions of formation of Schönite. The book also contains an account of the beautiful experimental methods worked out by van 't Hoff for the determination of transition-points.

The researches summarised in this book may be regarded as forming a fitting prelude to the great work which van 't Hoff undertook during his residence in Berlin, namely, the investigation of the formation of oceanic salt deposits, with special reference to those occurring at Stassfurth. This great geological problem was undertaken in collaboration with Meyerhoffer, and with the help of a number of research students. It reduced itself practically to the determination of the heterogeneous equilibria occurring in solutions containing the chlorides, sulphates, and borates of sodium, potassium, calcium, and magnesium. Proceeding step by step from the simple to the more complex solutions, and employing all the methods which he had previously worked out for determining equilibria and transition-points, van 't Hoff slowly but surely succeeded in unravelling the gigantic problem which he had set himself to solve. It would be quite impossible here to convey even a faint idea of the complexity of the task, and of the genius which enabled van 't Hoff to attack it so successfully. Probably no part of his life-work is less generally known than the wonderful series of researches which issued from his laboratory at Charlottenburg during the years 1896–1909, and yet it may be safely said that these researches constitute an absolutely fundamental advance not only in physical and inorganic chemistry, but also in scientific mineral synthesis and rational *experimental* geology. They will for ever remain the classical model for the application of the methods and principles of heterogeneous chemical equilibrium to the science of experimental mineralogy. Van 't Hoff published a collected account of these researches in two small volumes with the modest title, "Zur Bildung der ozeanischen Salzablagerungen" (Vieweg, Brunswick, 1905 and 1909.) This magnificent work on the Stassfurth salt deposits was the last great problem to which van 't Hoff devoted his attention. It forms a fitting close to a life of strenuous work and extraordinary scientific fertility.

In spite of the continuous labour involved in his daily work in the laboratory and in the publication of his researches, van 't Hoff found time, during his residence in Berlin, to publish his "Vorlesungen über theoretische und physikalische Chemie" (Vieweg, Braunschweig). This will long remain a standard work on theoretical chemistry. It is characterised by great originality of treatment, remarkable breadth of outlook, and that close and intimate relationship of fact and theory which was always one of van 't Hoff's salient characteristics.

Of other works may be mentioned a short summary of the "Theory of Solutions," published in Ahrens' "Sammlung chemischer Vorträge" (1900), and the delightful "Acht Vorträge über physikalische Chemie" (Vieweg, 1902), an embodiment of the lectures which van 't Hoff was invited to give at the University of Chicago in 1901 on the occasion of

the decennial celebrations of the foundation of that university.

Since its foundation, in 1887, van 't Hoff's name has been associated with the "Zeitschrift für physikalische Chemie" as one of its editors. In 1899 the thirty-first volume of that journal was devoted to a "Festschrift" in honour of the twenty-fifth anniversary of his doctorate, many of his old pupils and many other men of science contributing papers in honour of the occasion.

The above is but a brief and meagre account of the life-work of one of the greatest geniuses the world has ever seen. It would take many pages of this journal to convey anything like an adequate idea of the extent and originality of his researches. But the only true appraisement of van 't Hoff's work and influence is to be found in the living science of to-day and in the minds of countless thousands of scientific workers. As time rolls on his name and his work will stand out ever more prominently in the story of the development of chemical theory. We are still too near the mountain to be able to appreciate fully the grandeur of its heights.

The present writer is one of those whose privilege it is to have worked under van 't Hoff. That was in the days at Charlottenburg, when the investigation of the oceanic salt deposits was just beginning. Every day endeared van 't Hoff to the small band of workers in his laboratory. His joy in his work, the simple and unaffected friendliness of his nature, and the marvellous power of his mind affected us most deeply. All who worked with van 't Hoff quickly learned to love and respect him, and we were no exception to the rule. The kindliness of his heart and the simple charm of his manner were no less characteristic of him than the genius that is known to all.

With the passing away of van 't Hoff chemistry loses one of her greatest men. His was indeed one of the master-minds of science. All his work was characterised by the penetrating insight and the wide creative outlook of a lofty and commanding genius. When one reflects on the vast regions of knowledge which he either created or systematised and marvellously developed—stereochemistry, chemical dynamics, chemical equilibrium and affinity, the laws of solutions—the thought occurs to one that future ages will see in him the Newton of chemistry.

However that may be, chemical science, which to-day so deeply mourns his loss, will ever rank van 't Hoff amongst the greatest chemists of any age.

F. G. D.

NOTES.

THE death of the able and accomplished naturalist Prof. Félix Plateau occurred at Ghent on March 4 after a long and painful illness. Prof. Plateau only recently retired from the active duties of his chair of zoology in the University of Ghent, and was appointed *Professeur émerite*. From his earliest days he pursued the study of his favourite science with indefatigable energy, devoting himself, in the main, to the arthropods, and especially to the Insecta and their physiological and physico-chemical aspects. Though of slight build and apparent delicacy, yet he was enabled, since he visited the British Association in Liverpool in 1870, to carry out a long series of researches for more than forty years, enriching the literature of his subject in a noteworthy way with both pen and pencil. His labours embraced such subjects as the vision of arthropods (including insects), respiratory movements of insects, centre of gravity in insects, functions of antennæ, physico-chemical observations on aquatic insects, movements and innervation of the central organs of the circulation in insects, errors committed by Hymenoptera in visiting flowers, means of protection in Abraxas, observations as to whether the syrphides admire colours of flowers, and a large number of researches on the behaviour of insects with regard to flowers, natural and artificial, besides numerous papers on allied subjects. These memoirs were illustrated by his facile pencil, and were carried out with great labour and ingenuity by means of apparatus devised by himself. Prof. Plateau was a member of the Royal Academy of Sciences of Belgium, and was much esteemed for his amiability and wide culture. He will be greatly missed as an earnest and indefatigable investigator of that side of entomology from which modern science has been enabled to draw safe deductions instead of vague suppositions. He leaves a widow and several sons and daughters.

IT is difficult to believe that Viscount Dalrymple was serious in asking the First Lord of the Admiralty in the House of Commons on March 8 "whether he would arrange for the fleet to carry out their heavy gun-firing practice round the coast at some other period of the year than in the middle of harvest time, when the resulting heavy rain may cause serious loss to the farming community." Mr. McKenna answered the question evidently in the belief that it was asked in good faith; he began by saying "there is no evidence that the firing causes heavy rain," and we do not need to concern ourselves with the rest of the reply. No doubt, whether Lord Dalrymple was jesting or not, many people still cling to the belief in the power of explosions to produce rain, and we referred last week to several cases in point. In the new number of *Symons's Meteorological Magazine* Mr. F. Gaster points out that the firing of big guns is carried on more frequently at Shoeburyness than at any other point on the coast, but that the mean annual rainfall at Shoeburyness, and on the coast of Essex generally, is the lowest in the British Isles. This seems to be the most convincing form of reply to those who profess to believe, or do believe, in the efficacy of gun-firing to produce rain.

LORD CRAWFORD presided at the meeting on March 8, at the British Museum, to present Sir Edward Maunde Thompson, late director and principal librarian, with his portrait, painted by the president of the Royal Academy (Sir Edward Poynter), who is also a trustee of the museum. Among the subscribers were the Archbishop of Canterbury (appointed a trustee in 1884 by Queen Victoria), who made the presentation, the Speaker, Sir Henry Howorth, Lady (John) Evans, and the officers and assistants of the museum, including Mr. F. G. Kenyon (director and principal librarian), Mr. L. Fletcher, F.R.S. (director of the natural history departments), Mr. A. R. Dryhurst and Mr. C. E. Fagan (assistant secretaries), Mr. Basil H. Soulsby, and many others. The portrait will be exhibited at the Royal Academy, and may one day join the collection of portraits of principal librarians and trustees in the board-room at the British Museum, which includes the portrait of Sir Antonio Panizzi by G. F. Watts, and Sir Joseph Banks by Lawrence.

DR. ÖSTEN BERGSTRAND, for some time observer at the Upsala Observatory, Sweden, has been appointed professor of astronomy in the Upsala University and director of the observatory.

THE Belgian Maritime Association has engaged M. H. Phillipot, assistant in charge of the meridian service at the Uccle Observatory, as professor of astronomy on board

the Belgian naval college ship *L'Avenir*. The engagement is for six months, and the ship left Sunderland for Montevideo on March 9.

THE next triennial prize of 300*l.*, under the will of the late Sir Astley P. Cooper, will be awarded to the author of the best essay or treatise on "The Means by which the Coagulability of the Blood may be Altered." Essays, written in English, must be sent to Guy's Hospital, addressed to the physicians and surgeons, on or before January 1, 1913.

THE annual congress of French geographical societies is to be held this year at Roubaix, during the exhibition in that town, from July 29 to August 5, under the presidency of Prince Roland Bonaparte.

AT the recent meeting of the Australasian Association for the Advancement of Science in Sydney, the Mueller memorial medal was awarded to Mr. Robert Etheridge, curator of the Australian Museum, in recognition of the value of his numerous contributions to the palæontology and ethnology of Australasia.

A REUTER message from Portici states that on March 12 a portion of the crust around the crater of Vesuvius, 300 metres long and 24 metres in thickness, suddenly subsided, causing an appreciable shock of earthquake. Small portions of the crust continue to fall in, and a canopy of ashes is hanging over the mountain. As the result of the collapse the crater seems to be lower, and Vesuvius bears the appearance of having been decapitated.

WE learn from the Vienna correspondent of *The Times* that on March 9 the Austrian Academy of Sciences held a special sitting to celebrate the fiftieth anniversary of the appointment of the Archduke Rainer to be its curator. The Archduke marked the occasion by giving a sum amounting to about 4166*l.* to the academy as an endowment for those members who may need to keep in touch with the progress of their special branches of study in other countries.

ON Tuesday next, March 21, Dr. M. Aurel Stein will deliver the first of a course of three lectures at the Royal Institution on "Explorations of Ancient Desert Sites in Central Asia." The Friday evening discourse on March 24 will be delivered by Sir David Gill on "The Sidereal Universe," on March 31 by Prof. H. S. Hele-Shaw on "Travelling at High Speeds on the Surface of the Earth and above It," and on April 7 by Sir J. J. Thomson on "A New Method of Chemical Analysis."

PROF. VLAD. KULCZYŃSKI, the distinguished arachnologist, of Cracow University, is just concluding the thirtieth year of his scientific activity. The physiographical committee of the Cracow Academy of Sciences intends to commemorate this anniversary by presenting to him an album with photographs of his fellow-zoologists and friends, who are invited to send their photographs, together with at least 20 kronen (=17*s.*), to Prof. E. Godlewski, Cracow University. The surplus of the capital remaining after paying for the album will be used to cover the costs of editing the work "The Arachnological Fauna of Poland and the adjacent Countries." The special meeting of the physiographical committee, when the album is to be delivered to Prof. Kulczyński, will be held on March 24 at midday.

AT a special meeting lately held in the Berlin Royal Museum of Natural History, the committee for the exploration of the dinosaur-bearing deposits of German East Africa exhibited a few of the more remarkable specimens already received. The collection consists chiefly of the remains of Sauropoda, some much larger than the gigantic species of North America. One humerus measures more than 2 metres in length, and some of the cervical vertebræ are twice as large as those of Diplodocus. The leader of the exploring party, Dr. W. Janensch, reports the discovery of two new localities in which dinosaurian bones are abundant, and the chairman of the committee, Prof. W. Branca, is making an appeal for the gift of additional funds to continue the work.

THE discovery of Archæocyathinæ in a piece of limestone brought from the Antarctic continent by the Shackleton expedition, has excited renewed interest in these problematical Cambrian fossils. A typical series of specimens, obtained by Mr. Griffith Taylor, from South Australia, has accordingly been arranged for exhibition, with explanatory diagrams, in the Department of Geology, British Museum (Natural History). These organisms have now been discovered in the oldest fossil-bearing rocks in nearly all parts of the globe. Their form is that of two cups, one within the other, and their skeleton consists of granular calcite, not of spicules. The cups are pierced with perforations, and the space between the two is more or less subdivided by radial partitions and horizontal bars or plates, which are also perforated. The whole structure of the skeleton suggests that currents of water originally flowed through it, but its non-spicular construction prevents its reference to a sponge. It has even been compared with a calcareous alga, such as the existing Acetabularia, but the differences are so important that it is difficult to conceive of Archæocyathus as a primitive plant. In the museum the collection is placed between the Protozoa and the sponges.

WE record with regret the death, on March 9, of Colonel John Pennycuick, C.S.I., late R.E., at the age of seventy years. His name is best known in connection with the Periyar Diversion and the construction of the huge dam across the upper waters of the river Periyar, in the Travancore territory, and taking the water from the lake thus formed through a tunnel in the Western Ghats across to the opposite slope to supply the areas of the Madura district. Colonel Pennycuick was at the head of the Madras Public Works Department for several years, and retired in 1896, when he became president of the Royal Indian Engineering College at Coopers Hill, and held the post until the summer of 1899.

THE annual general meeting of the Ray Society was held on March 9, Dr. R. F. Scharff being in the chair. The report of the council stated that by the issue last year of part viii. of the "British Nudibranchiate Mollusca," for 1909, and of vol. ii., part ii., of the "British Annelids," for 1910, the publications had been brought up to date, and that for the present year two volumes were already in preparation, being vol. iv. of the "British Desmidiaceæ," with about thirty plates, and vol. iii. of the "British Tunicata," with sixteen plates, fourteen being coloured, completing that work. The balance-sheet showed a balance in hand of 55*l.* 2*s.* 8*d.*, with an investment of 1250*l.* Consols. The Right Hon. Lord Avebury was re-elected president, Dr. F. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

AT the meeting of the Royal Geographical Society on March 13, Dr. T. G. Longstaff described his crossing of the Purcell Range in British Columbia in the course of last summer. This range lies parallel to, but is distinct from, the Selkirk Range, and both, while situated along-

side the Rocky Mountains, are much older than the latter, representing in this region the original main axis of the North American Cordillera. The Purcell Range, like the Selkirks proper, attains no great height in its southern portion, but the northern half rises well above the snow-line in numerous glacier-clad peaks. The author was accompanied by Mr. Wheeler, a well-known Canadian mountaineer and topographer, who with theodolite and survey-camera made large additions to the survey of the region where the Dominion Government has of late suspended work to press forward that in more fertile areas. A large glacier which descends to the valley floor amongst the timber was visited, and its present phase was found to be one of retreat. Stations were occupied up to more than 8000 feet, and from the photographic survey 11,489 feet was determined as the height of the principal peak. This may be Mount Nelson or Mount Hammond, which, however, the author thinks may be identical. By the latter part of September it was necessary to leave the high valleys, after Mr. Wheeler had completed a considerable amount of surveying, and after the expedition had gained a general knowledge of the Purcell range and the location of its highest and most glaciated portions.

Mr. R. A. Leslie Moore amused his audience at the Royal Society of Arts on February 24 by an account of Indian superstitions—omens, the evil eye, spooks and goblins, mystic animals, birds, insects, reptiles, trees, and so forth. The learned student of custom and tradition who is familiar with the abundant literature gathered on this subject in India will find little that is novel in this pleasant but rambling paper, or in the discursive remarks of Sir G. Birdwood and other Indian authorities which followed. But the paper will have a useful effect if only by directing attention to the vast, and still only partially garnered, material which India can supply.

The recent death of Sir Francis Galton, the founder of the science of eugenics, naturally leads to a discussion in *The Fornightly Review* for March on the relation of eugenics to Mendelian genetics, contributed by Mr. G. C. Nuttall. The latter is working, and apparently on successful lines, to bring law and order into the inchoate mass of the facts of heredity; the former is striving to teach man to use his conscience, as well as his intellect, in dealing with this new knowledge. The writer believes it to be proved that feeble-mindedness could practically be stamped out in two generations if the State rigorously determined to check the perennial flow of the strain of the unfit into our national life. All this may be true; but the voice of the teacher is still that of one preaching in the wilderness. The remedy involves the seclusion of all persons defective in mind or body, a drastic method which our democracy, largely swayed by sentimental emotions, seems, for the present at least, not prepared to adopt.

The Public Works Department of the Government of Egypt has published a second edition of the List of Animals in the Zoological Gardens at Giza, near Cairo, compiled by Captain Stanley S. Flower, the director, and illustrated by twenty plates reproduced from photographs. The names of species inhabiting Africa (inclusive of Madagascar), Arabia, and Syria are respectively indicated by an asterisk. An important feature of the work is a record of the number of years specimens have lived in the gardens since Captain Flower took over charge in 1898. At the annual census, taken in October, 1910, the total number of animals living in the gardens was 1464, referable to 391 species, both these figures being higher than in any previous year.

In No. 1796 (vol. xxxix., pp. 489–93) of the Proceedings of the U.S. National Museum, Mr. R. L. Moodie describes a labyrinthodont from the Kansas Coal Measures, which is of interest alike on account of the rarity of such remains in that formation and from its own intrinsic characters; for this labyrinthodont, which is described as a new genus and species, *Erpetosuchus kansensis*, differs from all its relatives in the presence of a pair of oval vacuities on each side of the inner wall of the lower jaw, comparable to those of a crocodile, while it is further distinguished by the uniform character and shortness of its teeth. It is assigned to the family Labyrinthodontidæ. Greek scholars will regret that the genus was not named Herpetosuchus

Taking as his text a statement by Mr. C. B. Devonport, to the effect that self-coloured fowls, as being more conspicuous, tend to be eliminated by natural enemies, whereas barred birds, on account of being less conspicuous, are more immune to attack, Dr. Raymond Pearl, in the February number of *The American Naturalist*, states that he has found the alleged contrast in regard to conspicuousness to be well founded. On the other hand, as the result of experiment, he denies the truth of the theory based on these facts. "We have been prone," he writes, "to agree that because an organism was coloured or formed in such a way as to be inconspicuous, it was, therefore, necessarily protected from attack by its enemies. . . . The logic of such reasoning is flawless. . . . But a conclusion may be perfectly logical and still not true. In the study of protective coloration, including mimicry, it is essential that a discovery that an organism is to human eyes inconspicuous or not readily distinguishable from some other organism shall not be considered the final goal."

The recent appearance in vast numbers of the giant African snail *Achatina fulica* in Ceylon forms the subject of an article by Mr. E. E. Green in the February issue of *The Zoologist*. This bulimus-like species is a native of East Africa, but appears to have been introduced many years ago into Mauritius, where it is now common. To Calcutta it was introduced about half a century ago, and by 1877 was abundant in the gardens of the houses in Chominghi, while it had also crossed the Hughli to Howra and Barrakpur. About ten years ago a collector introduced the species on his estate in the highlands of central Ceylon, but soon after attempts were made to exterminate the intruders, and it was believed effectually. It appears, however, that some escaped destruction, and of these a couple were recently carried down with vegetables to the low country. Here they increased to such an amazing extent, over an area of about five square miles, that their numbers were to be reckoned by millions, no fewer than 227 being counted in a cluster on the stem of a cocoanut palm in a length of about 6 feet. Naturally the natives were in fear that their crops would be devastated; but, as a matter of fact, little or no serious damage has been inflicted, and it appears that the species largely acts the part of a scavenger, so that in some degree, at any rate, its introduction is a benefit. The adults are attacked by a terrapin of the genus Nicoria, and in its young stages the species probably has many foes. The enormous fecundity of these snails on their first introduction to the lowlands was probably a temporary phenomenon, and their numbers now appear to be diminishing.

Dr. Rudolf von Ritter-Záhony gives (Fisheries, Ireland, Sci. Invest., 1910, iv.) an account of the Chætognatha taken during the years 1905–6 off the coast of Ireland. As was to be expected in the surface waters

of the temperate zone, the group is almost solely represented in the Irish epiplankton by *Sagitta bipunctata* and *Spadella cephaloptera*; *Sagitta serratodentata* also occurs, but is comparatively rare, and only a few young *Eukrohnia hamata* were observed. In the mesoplankton the first two forms were entirely absent; *E. hamata* predominated there, and with it were nine other species, some entirely confined to the mesoplankton, while others were found there only in the adult condition after having passed through their earlier stages of development in the epiplankton of warmer seas. In the same publication (v.) Messrs. E. W. L. Holt and L. W. Byrne give a list of 103 fishes of the Irish Atlantic slope, taken beyond the 100-fathom line, with references to the memoirs in which they are described.

An insect pest of the camphor trees on the main island of Japan and Formosa, in the shape of a new species of the Psyllidæ, *Trioza camphorae*, is described by Prof. C. Sasaki in the Journal of the College of Agriculture, Tokio University (vol. ii., No. 5). The larvæ give rise to flattish button galls on the leaves.

The first article in vol. xxviii. of the Journal of the College of Science, Tokio University, is devoted to short botanical studies from the tropics, by Prof. M. Miyoshi. Discussing the characters of tropical foliage leaves, he notes the tendency to produce firm entire leaves with a smooth or shining surface. Data are also supplied with regard to the manner in which leaves are wetted by rain. Another note refers to the Indian cherry tree *Prunus Puddum*, confirming the suggestion made by Sir J. D. Hooker that it is allied to the Japanese mountain cherry *P. pseudo-cerasus*, which it resembles in flower characters; from *P. campanulata* it differs markedly in the form of the fruit.

A third paper embodying researches upon the sexual organs and reproduction in the cycad, *Dioon edule*, in this case dealing with fertilisation and embryogeny, is contributed by Prof. C. J. Chamberlain to *The Botanical Gazette* (December, 1910). In Mexico, fertilisation takes place during the month of April. The sperms escape through the ruptured end of the pollen tube with a small amount of liquid of high osmotic value, and one nucleus enters the egg, often slipping out of its ciliated sheath as it squeezes past the neck cells; it is suggested that the passage is prepared by the liquid issuing from the pollen tube, which plasmolyses the neck cells. After fertilisation a number of free nuclei are formed; then there is a distinct but evanescent formation of cell walls throughout the entire proembryo which only materialises into walls at the basal end where suspensor and embryo are differentiated.

Experiments are continuously being conducted in the West Indies to obtain varieties of sugar-cane suited to the various soil and climatic conditions in the different districts of the islands. Numbers of new canes are raised from seed annually, and promising plants are carefully propagated; analysis is then made of the juice. Details of experiments conducted on these lines are given in Pamphlet No. 66, recently issued by the Imperial Department of Agriculture for the West Indies.

The official forecast of the wheat crop of South Australia is put at 11·91 bushels per acre, this being 1·35 bushels fewer than the actual yield obtained twelve months ago. So late as last September it was thought that the present harvest would be 20 per cent. greater than the previous one, but an unusually severe attack of disease, locally known as "takeall," has since set in, and has in some cases destroyed entire crops. The disease is caused by the fungus *Ophiobolus graminus*, an interesting account of which occurs in *The Journal of Agriculture for South Australia* (No. 5). It is urged that a plant pathologist is needed for the study of crop diseases, which, according to the writer, cause a loss of nearly half a million of money each year in South Australia alone.

From the report of the Botanic Station, Experiment Plots and Agricultural School, Dominica, 1909–10, we learn that the general conditions of the gardens is satisfactory. A strong feature of the work is the distribution of material for planting purposes. More than 79,000 plants were sent out during the year, as well as large numbers of seeds. The experiments with economic plants include, among others, trials with spineless limes, varieties of citrus plants, Para rubber, and grafted cacao. The lime industry appears to be well established, and the conditions of production are steadily improving. Para rubber continues to do well in the wet districts of the island. Much remains to be done in improving the cacao industry; it is considered that the yield might be considerably higher if better methods were more generally used.

Dr. E. J. Butler has been appointed director of the Agricultural Research Institute and College, Pusa, in place of Mr. Coventry, who is now Inspector-General of Agriculture in India. The annual report of the work of this institution describes the chief investigations carried on by the various departments. In the botanical department Mr. and Mrs. Howard are continuing their work on wheat, and are obtaining very promising results. Dr. Leather's work on the water requirements of plants is calculated to afford information valuable alike to the agriculturist and the irrigation engineer. Much attention is paid in the entomological department to industries that depend on the products of insects, eri, mulberry, tussor silk, and the cultivation of lac being the chief. The mycologist has carried out important investigations on the blister blight of tea and the palm disease in the Godavery Delta. A bacteriological section has been added, and a cotton expert appointed.

In the *Bolletino della Società geografica Italiana* for February, Major A. Tancredi, who has done much to advance our knowledge of the climate of Eritræa, describes the salt plain lying to the east of the Abyssinian tableland. Situated at about 110 metres below sea-level, and forming an area of inland drainage, it has a mean temperature of about 31° C., while the maximum in summer is said to reach 50° C. From the salt deposits here formed, the Abyssinian merchants obtain the blocks of rock-salt which are used as currency throughout the country, rapidly rising in value towards the more remote western parts of the tableland. The volcano of Ert-Alé to the southward was seen from the hills above the Saline of Assale, but was not visited.

From the results of the Swedish expedition to Spitsbergen in 1908 under Prof. G. de Geer, we have received a first part containing the hydrographical observations by N. von Hofsten and S. Bock. The temperature and salinity of the sea were determined at about thirty points both on the outward and the homeward voyage. These factors showed a marked increase on the conditions which existed about 1902, when ice in August still surrounded the southern portion of Spitsbergen, and indicated a return to such as existed in 1898, when the Nathorst expedition could sail round Spitsbergen and visit Gills Land. The topography of Eisfjord, on the western coast of Spitsbergen, was studied during the second half of July and

August, as well as the hydrographical conditions, which showed that the warm salt Atlantic water flows into the fjord, and has there its temperature and salinity lowered by the glacier ice descending from the land.

In the Monthly Review of the Seismic Activity of the Earth's Crust, issued by the Kaiserl. Hauptstation für Erdbebenforschung in Strassburg, we find for June, 1910, references to forty-seven earthquakes. A few of these were destructive, but the greater number appear to have been local tremors. For each of these disturbances we have the date, the time (local and Greenwich), the character of the movement, its duration, direction, and general remarks. The fact that Japan records, on the average, 100 earthquakes per month, and the world probably experiences several thousands, it seems extremely likely that this publication will increase in size, but, as it stands, it must frequently be of great value in the interpretation of teleseismic records.

The Canadian Department of Mines has issued two advance chapters of the annual report on the mineral production of Canada during the year 1909. Each chapter is by Mr. John McLeish, chief of the division of mineral resources and statistics; one deals with the production of iron and steel in Canada in 1909, and the other with the production of coal and coke. The former industry showed a very satisfactory and steady growth as compared with previous years, but the coal-mining industry was marked during 1909 by a decreased production in Nova Scotia and an increased production in the western provinces, resulting in an aggregate decrease for the whole of Canada of 384,836 tons (short tons of 2000 lb.), or about 3½ per cent. Although iron ores are of wide occurrence throughout Canada, being found practically in every province, the development of these resources has not kept pace with the growth of Canadian metallurgical industries. About 17 per cent. only of the iron ore used in Canadian furnaces during 1909 was of domestic origin. Much of the coke and limestone also was imported, so that Canadian iron industries are now, and have been for a number of years, largely dependent on imported raw material. Coal mining has long been the most important of Canada's mining industries, and in 1909 is credited with 27 per cent. of the total mineral production of the country. The output in 1909 is more than twice that of ten years ago, about four times the output of twenty years ago, and nearly ten times the production of 1879. Notwithstanding its large coal resources, Canada's total coal production in 1909 was only about 56·4 per cent. of the estimated consumption, and the additional requirements were supplied by imports, chiefly from the United States.

The meteorological chart of the Indian Ocean for March, issued by the Meteorological Committee, quotes several cases of phosphorescent seas that have been observed in recent years. Among the most interesting is one forwarded to the Danish Meteorological Institute by Captain Gabe in the Strait of Malacca in June, 1909. Luminous waves were observed travelling from west to east, and gradually assumed the form of long arms, with dark intervals between them. These issued from an apparent focus, around which they rotated, which seemed to be on the horizon. An illustration of the phenomenon shows that the beams of light were somewhat curved, the concave edge being in the direction of rotation (clockwise). The brightness lasted about a quarter of an hour. A somewhat similar case of rotatory light system was observed by Captain Breyer in August last near the Natuna Islands, but the direction of rotation round the apparent focus in this instance was anti-clockwise.

In the *Verhandlungen der Deutschen Physikalischen Gesellschaft* for February 15, Prof. M. Planck removes one of the difficulties in the proof of his expression for the radiation from a perfectly black body. It will be remembered that the proof depended on the assumption that a simple Hertz oscillator could only possess an amount of energy which was an integral multiple of a certain small quantity of energy, or, in other words, that energy was atomic in structure, and emission and absorption of energy must take place by "atomic" steps. In the present paper Prof. Planck shows that, although emission must still take place in steps, absorption may be taken as continuous, and the amount of energy possessed by an oscillator at any instant may be a fractional number of "atoms." If, however, the probability that the oscillator emits an "atom" of energy be taken proportional to the whole number of "atoms" of energy it possesses, the fractional excess being disregarded, the final expression for the energy radiated by a perfectly black body in terms of temperature and wave-length becomes identical with that formerly given.

In a recent short publication of the Royal Observatory of Wilhelmshaven, the new director, Captain Capelle, explains how it is proposed to deal with arrears in the publication of magnetic work of that institution, and introduces a discussion of the magnetic character of the year 1910, by Prof. Bidlingmaier, who is now a member of his staff. Dr. Bidlingmaier regards the degree of disturbance of each individual hour as given by the numerals 0, 1, or 2, according to the extent of the departure of the corresponding portion of magnetic curve from the position characteristic of that hour on the average quiet day. The character of the hour is shown graphically by the colour of a small square, white, shaded, or black. The squares for adjacent hours and days are juxtaposed, so that the information is given for a whole month in a rectangular area about 80×65 mm., and that for a whole year in a couple of pages. Summing the numerical values for any specified number of hours, and taking the mean, a numerical measure is obtained for the average disturbance of the period, and certain conclusions are drawn as to the reality of 24-hour and 30-day disturbance periods. Whether the character of the hour is determined solely by reference to the horizontal force is not clear. A fuller explanation seems to be in view. The definition of disturbance presents a considerable resemblance to Sabine's, and whether it will commend itself to the general body of magneticians remains to be seen.

The Bulletins of the Cracow Academy of Sciences for 1910 contain three important papers by Prof. L. Bruner and his colleagues on photo-chemistry. The first action studied was that of light in promoting the conversion of maleic into fumaric acid in presence of bromine. In the absence of light, the bromine merely combines with the two acids to form dibromosuccinnic acids, the action proceeding fifteen times more quickly with maleic than with the more stable fumaric acid. In presence of light, perhaps because the bromination may become reversible, the main action is to cause the maleic to change into fumaric acid. This change, which is not effected in presence of chlorine or iodine or of the compounds ICl and ICl_3 was traced by measurements of conductivity and of solubility. The amount of fumaric acid finally produced depends on the nature of the light, but if this is fixed there is a definite ratio between the fumaric acid produced and the bromine used; by increasing the quantity of bromine, the maleic acid can be changed completely into fumaric acid. These observations reveal a striking contrast with catalytic

actions in which light is not concerned, since the concentration of the catalyst is then without influence on the final equilibrium between isomers. Other characteristics of photo-chemical action were shown by the investigation of the bromination of toluene under the influence of light. This action is extraordinarily sensitive to the presence of oxygen, which appears to give rise to oxidised bromine-compounds which carry on the action after the light has been removed; bromination in the side chain can, indeed, be effected almost violently *in the dark* if the material is subjected to the action of slightly ozonised oxygen, which thus acts as a most efficient "carrier" of bromine to the side chain. When these disturbing effects were got rid of by exclusion of oxygen and the addition of a little iodine, the velocity of bromination was found to be independent of the concentration of the bromine, *i.e.* equal quantities of bromine were used in equal times throughout the action. The action of various wave-lengths of light was determined with the help of a mercury lamp and light-filters, but all wave-lengths absorbed by the bromine appeared to take part equally in the photo-chemical action.

An account of a Garratt locomotive made by Messrs. Beyer, Peacock and Co., Ltd., of Manchester, for the Darjeeling-Himalayan Railway, appears in *The Engineer* for March 10. This railway is of 2 feet gauge, and presents peculiar difficulties on account of the steep ascent and frequent loops or spirals and reverses, one of the latter having gradients of 1 in 28. Curves of 70 feet radius are numerous. The specification for the locomotive included the condition that it should be able to travel over reverse curves of 60 feet radius with a length of tangent between the curves of 20 feet only. The engine consists of a girder frame, which is pivoted and supported at its extreme ends on four-wheeled bogies. Each bogie is a miniature locomotive *sans* boiler. The boiler supplying both is carried between the bogies on the girder frame. As there are no wheels under the boiler, the size of boiler is practically unrestricted. There are four cylinders each 11-inch diameter by 14-inch stroke, and fitted with Walschaert's valve gear.

Prof. Emil Fischer's lecture on "Neuere Erfolge und Probleme der Chemie," of which a translation appeared in Nature of February 23, has been published by the firm of Julius Springer, Berlin, price 0.80 mark.

OUR ASTRONOMICAL COLUMN.

The Spectrum and Orbit of o Persei.—In No. 10, vol. ii., of the Publications of the Allegheny Observatory, Mr. Frank C. Jordan discusses the spectrum and orbit of the spectroscopic binary o Persei. From a discussion of seventy plates, taken with the Mellon spectrograph during 1908–9, he finds that, instead of a radial velocity of -3 km., as found by Vogel, the centre of the system has a radial velocity of $+18.5$ km.; the orbit is practically circular, and the period is 4.4192 days.

The most striking fact educed by Mr. Jordan, however, is that the H and K lines of calcium do not appear to participate in the displacements due to motion in the line of sight shown by the other lines. In other words, whilst helium, hydrogen, magnesium, and carbon lines in the star's spectra indicate that the star is revolving in a circular orbit, the H and K lines indicate that the calcium vapour producing them is moving with a constant velocity away from us. Prof. Hartmann found the same phenomenon in the spectrum of δ Orionis, and, as the apparent velocity derived from the K line differed by 7 km. from the velocity of the centre of the system, he suggested that the calcium absorption took place in a medium lying between us and the star; such a suggestion is strengthened by the fact that most stars exhibiting this peculiarity lie in nebulous regions. But Mr. Jordan is inclined to question the difference of 7 km., which might be obviated by adopting other standard values for the wave-length of K, and, very tentatively, suggests that a clue to the phenomenon may be found in the fact that, of eleven stars exhibiting the peculiarity, ten are strong helium stars.

The Determination of Latitude.—While the Talcott-Horrebow method of determining latitude is the most important from the point of view of accuracy and facility of application, it generally necessitates the use of a specially constructed instrument, the zenith telescope. But in No. 4481 of the *Astronomische Nachrichten* Mr. Kiyofusa Sotome, of the Tokio Observatory, explains how the method may be used in connection with an ordinary field theodolite. Three wires, one vertical and two others 45° from the vertical, cross at the centre of the field of the telescope, and are carried by a reticle in the focal plane. Then a pair of stars are observed, circle east and circle west, and the time-intervals between the transits are noted. Knowing the declinations of the stars, Talcott's method gives the latitude, after the application of various corrections. Mr. Sotome explains the method in detail with formulæ, and shows that reasonable errors in the time intervals will not seriously vitiate the results. A series of seven observations at Tokio gave a mean error of $\pm 0.80''$, with a probable error of a single observation of $\pm 1.63''$.

The Relation between the Separation and the Magnitude of Visual Double Stars.—In No. 176 of the Lick Observatory Bulletins, Dr. R. G. Aitken analyses the degree of separation and the magnitudes of the double stars, brighter than magnitude 9.5 and closer than 5.0″, given in several large catalogues, and finds that the numbers of doubles consistently increase as one passes from the wider to the closer pairs. He also finds that the number of doubles of every distance-class under 5.0″ increases with increasing numerical magnitude; for instance, for B.D. stars as bright as magnitude 8.0 the proportion of doubles separated by less than 5.0″ is about 1 in $13\frac{1}{2}$, but for B.D. stars between magnitudes 8.0 and 9.0 the proportion is only 1 in 25.

Halley's Comet.—Already the periods of observation, both before and after perihelion, of Halley's comet, have easily exceeded those of any previous return; but observations are still being made at many observatories, and are likely to be continued for some time. M. Gonnessiat reports, in *Astronomische Nachrichten*, Nos. 4480–1, that on December 7 the magnitude was about 13.5, and that on February 25 it was 14.0.

In No. 4478 of the same journal Herr M. Ernst places on record his observations of the comet's magnitude on a number of dates extending from September 12, 1909, to June 30, 1910; his magnitudes for May 16 and 22, 1910, are -0.1 and -0.2 respectively.

The Path of Comet 1886 I.—More than one hundred columns of the *Astronomische Nachrichten*, Nos. 4477–8, are taken up by an exhaustive discussion, by Dr. Erich Redlich, of the available observations of the large comet 1886 I. After giving and discussing each observation in detail, Dr. Redlich derives a set of elements which give the eccentricity of the orbit as 1.0004461 ± 0.0000141.

Nova Lacertæ.—The faintness of this nova and the almost persistent cloudiness of our skies have prevented any extensive recent observations. In No. 4476 of the *Astronomische Nachrichten*, however, Prof. Millosevich reports that on February 10 the magnitude was 8.8.

Earthshine on the Moon.—To the casual observer of the heavens, the earthshine on the moon is deeply mysterious. On the evening of March 4, when our satellite was in conjunction with Saturn, the earthshine, as seen from Leeds, was unusually distinct, and many people, says Mr. J. H. Elgie in *The Yorkshire Post*, were led to believe that an eclipse was in progress. Mr. Elgie's observations showed that in the twilight the glow was of ashen hue, but that it deepened into olive as darkness came on.

Observations of Saturn.—On September 29, 1910, Signor Mentore Maggini, of the Ximénien Observatory, Florence, observed a bright projection on the limb of Saturn, and announced his observation in No. 4445 of the *Astronomische Nachrichten*. In the current number of *L'Astronomie* (March, p. 114) he gives further details, illustrated by an excellent plate drawing of the planet. He also describes various other phenomena observed during many nights of excellent seeing in September and October. Among others, he notes the dark equatorial band as double, the northern part being formed of oval spots, which at moments of good seeing gave the band the appearance of a chaplet. A difference of colour between the two annuli of this double band was also noted, the more southerly band having a greenish colour, the other being more of a reddish hue. The bright equatorial band, usually yellow, was often disturbed by greenish-grey shadings. Festoons, similar to those seen on Jupiter by Mr. Scriven Bolton, were frequently noted, seven of them being seen on September 30, 1910. Many other interesting phenomena appertaining to the rings, &c., are recorded by Signor Maggini.

THE GALTON BEQUEST.

Sir Francis Galton, F.R.S., who died on January 17, at the age of eighty-eight, has left the residuary estate under his will, amounting to about 45,000*l.*, to the University of London for the purpose of encouraging the study of national eugenics, which is defined in the will as the study of "the agencies under social control that may improve or impair the racial qualities of future generations, physically and mentally." Primarily, the object of the bequest is the establishment and endowment of a professorship in the University to be known as "The Galton Professorship of Eugenics," with a laboratory or office and library attached thereto; and the testator expresses a desire, without binding the Senate of the University, that the professorship shall be offered to Prof. Karl Pearson, F.R.S. The new professor will collect and discuss materials bearing on eugenics, form a central office to provide information to private individuals or public authorities concerning the laws of inheritance of man, and will urge the conclusions as to social conduct which follow from such laws. In addition, he will be required to extend the knowledge of his subject by teaching and research. The wish is expressed that the Senate will supply the laboratory or office, preferably, in the first instance, in proximity to the Biometric Laboratory, which is at present under Prof. Pearson's control at University College.

By this generous benefaction, permanent provision will be made for the work which has been carried on in the Francis Galton Laboratory in the University since October, 1904. This work was initiated by Sir Francis Galton, who supplied funds amounting to 3500*l.* during his lifetime for its support. Apart from the cost of printing the publications of the laboratory, nearly the whole of the money available has been devoted to the payment of the staff of the laboratory, including the emoluments of the Galton research fellow (Mr. David Heron) and the research scholar (Miss E. M. Elderton). A large number of lectures have been delivered in connection with the laboratory, and these have been well attended. The publications of the laboratory include "Noteworthy Families (Science)," by Galton and Schuster; a series of memoirs, of which fifteen have so far been published; a series entitled "Questions of the Day and of the Fray" (one publication); and a lecture series (six publications); in addition, the staff of the laboratory has published a number of papers in *Biometrika* and other periodicals. The subjects of the publications cover a wide range, including the principles of heredity, with special reference to insanity, vision, alcoholism, and various diseases and deformities. Some of the publications, notably those on alcoholism, have given rise to vigorous controversy. The laboratory has been fortunate in securing the cooperation of a large number of men of science and medical men.

The report on the laboratory published in the appendix to the second report of the Royal Commission on University Education in London (p. 399) indicates in a brief manner the ideas of those controlling its work as to future developments. The Solvay Institute at Brussels is mentioned as a possible model of what the Eugenics Laboratory should become; but for such a scheme a capital expenditure of 20,000*l.* and an annual income of 4000*l.* would, it is stated, be required, or an annual income of 5000*l.* if a sinking fund were established to repay capital expenditure in twenty years. The staff would then include a director (800*l.*), a trained actuary (600*l.*), medical officer (600*l.*), and six assistants (1200*l.*), the balance being used for library, publications, upkeep of buildings, and sinking fund. Those who have visited the Solvay Institute at Brussels will realise the great boon which such a scheme would confer on students of social questions in London. The arrangements made for private workers in the Brussels institute are as perfect as could be devised. Each worker has a private room, and the resources of the institute in books and information are placed entirely at his disposal. In close proximity to the institute for social workers at Brussels, are similar institutes for research in physiology and other sciences.

It may be of interest to note, in conclusion, the clear indication expressed in the will of Sir Francis Galton's desire that the work for which he has so generously provided shall have a direct bearing on practical life and on legislation. This side of the work has given rise to many misconceptions as to the character of the new science, which is popularly suspected of proposing artificial restrictions on the community in connection with marriage and child-birth. It may be said that there is little in the publications of the laboratory staff to support this view, though other exponents of the subject have expressed themselves with greater freedom and less regard, perhaps, to scientific data. As a good example of the way in which the new subject may affect legislation, Prof. Pearson's lecture entitled "The Problem of Practical Eugenics" may be mentioned, in which the effect of factory legislation on the birth-rate is explained in simple, non-technical language. The lecture provides at once an object-lesson for legislators and an admirable illustration of the use of statistics in the study of social questions.

T. Ll. H.

STANDARD TIME IN FRANCE.

At midnight on March 10 the clocks at the railway stations and all Government offices and municipal buildings of France and Algeria were set back nine minutes twenty-one seconds, to bring them in accord with Western European or Greenwich time, which will now be used in those countries, as it is in most other countries of Western Europe. The Paris meridian will, however, continue to be used as a standard for naval, astronomical, and cartographical purposes. A reform which has been urged in France for many years has thus at last been accomplished, and there can be no doubt as to the wisdom of the act, whether considered from the point of view of convenience or from that of international standards. It is not so much a question of the adoption of Greenwich time instead of Paris time as of France coming into a system of time-reckoning adopted by almost all the great countries of the world.

The zone-system of standard-time meridians separated by hours or half-hours, and encircling the globe, has undoubted advantages, and France occupied an anomalous position while it retained a time-standard having no simple relationship with the international system. The originator of this system was Sir Sandford Fleming, who, since he first suggested it in 1878, has done much to bring about the unification of time-reckoning throughout the world. Thanks to his persistent advocacy, twenty-four meridians are now recognised, beginning with that of Greenwich and counting towards the east. The time of each of these meridians is thus one hour behind that of the next meridian to the east of it, and one hour in advance of the next meridian to the west. Each meridian may be regarded as the median line of a zone 15° of longitude in width, so that the twenty-four meridians give standard-times on an organised system for the whole world. Local circumstances sometimes make it convenient to adopt the time of a meridian half-way between two of the twenty-four meridians, but this only means that the time will differ

from other times in the system by an odd half-hour as well as an exact number of hours.

The subjoined table, adapted from one in "Hazell's Annual," shows the standard meridians used by various countries, with which France has now come into line:—

Standard Times.

Greenwich Time..	Great Britain, Spain, Belgium, Holland
1h. fast on Greenwich	Italy, Austria-Hungary, Switzerland, Germany, Denmark, Norway, Sweden
2h. fast	Cape Colony, Transvaal, Orange River Colony, Natal, Turkey, Egypt
4h. ,, ...	Mauritius and dependencies (except Chagos) and Seychelles
5h. ,, ...	Chagos Archipelago
$5\frac{1}{2}$h. ,, ...	India
$6\frac{1}{2}$h. ,, ...	Burma
8h. ,, ...	West Australia, Coast of China from New-chwang to Swatow, up Yangtse to Hankow, Hong Kong, Labuan, British North Borneo
9h. ,, ...	Japan, Philippines
$9\frac{1}{2}$h. ,, ...	South Australia
10h. ,, ...	Victoria, Queensland, New South Wales, Tasmania
11h. ,, ...	New Zealand
1h. slow	Iceland
	America—
4h. ,, ...	Atlantic
5h. ,, ...	Eastern
6h. ,, ...	Central
7h. ,, ...	Mountain
8h. ,, ...	Pacific

Russia, Portugal, and Ireland still remain outside the system; but perhaps the example now set by France in sacrificing national sentiment to a scientific principle will induce these countries to link up their times with those of other nations by the adoption of convenient meridians simply related to those of the international standards.

A LONDON INSTITUTE OF TECHNICAL OPTICS.

A SCHEME for the establishment of an Institute of Technical Optics has now been approved by the Education Committee of the London County Council, and will shortly come before the Council. The object of this scheme is the establishment in London of an Institute of Technical Optics for the widest possible training of opticians and optical instrument makers, and it is also hoped that valuable work may be done in connection with investigations in optical glass, for which this country now so largely depends upon imported supplies.

The Education Committee proposes that the Council shall grant 35,000*l.* for the building and equipment of the new institute, the site, valued at about 12,000*l.*, having been already provided by the Northampton Polytechnic Institute, under the direction of the governors of which the new institute will be maintained. To ensure that the work shall be on the best lines, it is proposed to appoint a consultative committee representative of the trade, scientific, and other organisations interested.

The new institute will be maintained from funds at present used to maintain the Technical Optics Department of the Northampton Polytechnic Institute, additional grants from the Board of Education, and additional contributions from the London County Council. Later it is hoped that, in view of the national character of some of the work which may be developed, assistance may also be obtained from imperial funds.

In the proposals under consideration, provision is made for the teaching of optical science with its technical applications, and of other subjects of value to the manufacturer and designer of optical instruments, and to the optician.

Such instruction will be given in day and evening classes, the former being arranged to train men for positions as captains of industry in the trade, while the latter will be chiefly concerned with improving the technical and scientific equipment of those already engaged in the trade. In addition to the necessary auxiliary subjects, such as mathematics, drawing, elementary physics, &c., the courses would deal with (*a*) the theory of optics and optical systems, the design of optical systems, the methods of manufacture, and the testing of lenses and other optical work; (*b*) the principles, design, and construction of optical instruments (such as telescopes, microscopes, spectroscopes, photographic apparatus, surveying and other instruments, &c.), their adjustment, testing, and use; (*c*) the manufacture, testing, &c., of spectacle frames and lenses; (*d*) physiological optics.

In the various courses suitable laboratory and workshop classes will be included. The day courses will train men, some of whom may be recruited from the universities, as designers, test-room and general technical assistants, or as retail opticians, the evening classes in corresponding branches supplying theoretical and laboratory knowledge to men already engaged in the trade.

Day classes are also proposed for boys who intend to enter the optical trades as lens workers or instrument makers; these courses would take the place of part of the time of apprenticeship; they would probably be on the general lines of such courses held in connection with other trades. In addition, workshop classes, associated with elementary theoretical classes, would be provided for workmen desirous of becoming foremen or of improving their work in special directions. Facilities for research work on technical problems will also be provided, and students encouraged to pursue such investigations under the direction of a carefully selected and capable staff. Special investigations of questions of general interest to optical instrument makers, as, for instance, the questions connected with optical glass, will also be undertaken.

The above is a bare statement of the character of the proposed institute, and the funds which it is hoped will be available for its establishment and maintenance. Nothing has been said of the very strong arguments upon which the case for the founding of such an institute rests. These are embodied in two elaborate reports covering nearly forty pages of foolscap print, and signed, respectively, by the education officer (Mr. R. Blair) and the educational adviser (Dr. Garnett) of the London County Council. The wide reaching and important character of the work to be undertaken is very fully set out, and it is scarcely too much to say that these reports contain food for serious thought for every scientific worker in physical, chemical, and natural science.

THE STEREOCHEMISTRY OF NITROGEN.

AT the end of December, 1909, attention was directed in these columns (vol. lxxxii., p. 266) to the preparation by Profs. Perkin, Pope, and Wallach of an acid of the formula

$$\begin{matrix}H\\CH_3\end{matrix}\!>\!C\!<\!\begin{matrix}CH_2-CH_2\\CH_2-CH_2\end{matrix}\!>\!C\!=\!C\!<\!\begin{matrix}H\\COOH\end{matrix}$$

which contained no asymmetric atom, but which was capable of existing in two enantiomorphous forms—each having a large optical rotatory power—because the molecule, as a whole, was devoid of any plane of symmetry.

This important method of investigation has been extended to the stereochemistry of nitrogen by Dr. W. H. Mills and Miss Bain, whose observations are recorded in the Chemical Society's Journal. The substance investigated was the oxime of the formula

$$\begin{matrix}H\\HO.CO\end{matrix}\!>\!C\!<\!\begin{matrix}CH_2-CH_2\\CH_2-CH_2\end{matrix}\!>\!C\!=\!N.OH.$$

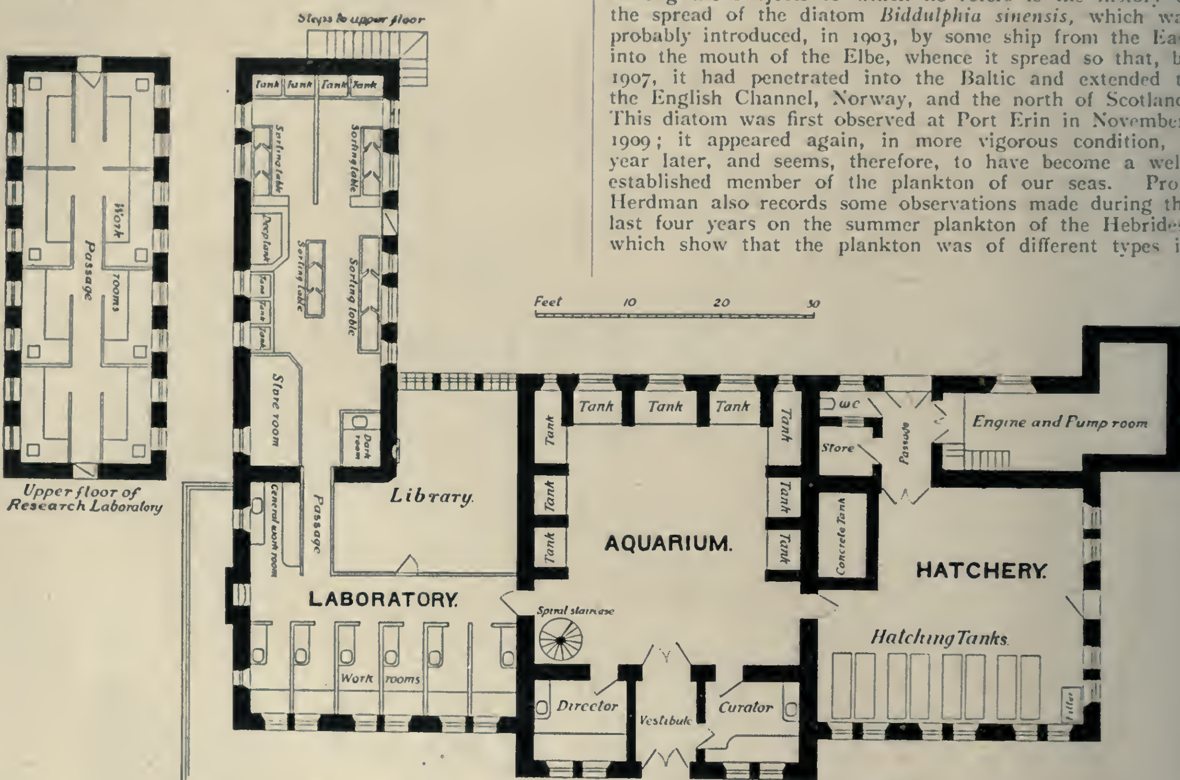
This oxime is obviously not symmetrical on either side of the plane of the ring, but would possess a plane of symmetry perpendicular to the ring if it could be assumed that the hydroxyl-group is situated in this median plane. The view that the hydroxyl-group is not situated in the plane of the remaining valencies of the nitrogen atom was advanced by Hantzsch and Werner in order to account for the isomerism of certain aromatic oximes, but was based upon somewhat slender evidence. In the case of the oxime formulated above, the matter can be tested directly by determining whether it can exist in optically active forms or not. The experiments show that the resolution of the oxime can actually be effected by means of morphine or quinine. It has a high rotatory power, not less than

$[M]_D \pm 91°$, but this is evanescent, the compound racemising rapidly and becoming inactive in the course of a few minutes or hours.

From its marked optical activity, it is clear that the oxime is asymmetrical in its structure; this probably applies both to the hydroxime $>C=NOH$ and to the isoxime $>C<\begin{smallmatrix} NH \\ | \\ O \end{smallmatrix}$ forms of the compound, but further work with derivatives of both types would be of great value in determining the range over which the lack of symmetry extends.

MARINE BIOLOGY AT PORT ERIN.

THE twenty-fourth annual report of the Liverpool Marine Biology Committee, dealing with the year's work of the Port Erin Marine Biological Station, affords ample evidence of the continued activities of this station. Details are given of the recently built research wing, the equipment of which is being pushed forward so as to be ready for use during the coming Easter vacation. This wing, 44 by 18 feet, two storeys high, contains on the ground floor a photographic dark-room, and a large and two smaller tank-rooms suitable for experimental work in biochemistry, comparative physiology, and embryology of marine animals. These three well-lighted rooms have cemented floors and walls, and are well provided with concrete tanks, of different sizes and depths, over which there are taps giving abundant supplies of sea water. Over a large central concrete platform, on which aquaria can be placed, will be a "plunger" apparatus for keeping in motion the water in the aquaria in which small animals are being reared. The upper floor contains eight separate rooms, each with about 13 feet of working bench, a sink, and supplies of fresh and sea water, which make an excellent addition to the accommodation available to research workers and senior students.



Plan of the Port Erin Biological Station, showing both Floors of the new Research Wing.

The report gives an account of the work done in the first course on oceanography, held at the station during August last. The usual work of the laboratory, in connection with research and the instruction of senior students, has been carried on; fifty-seven researchers and students have occupied the working places during the year. Mr. Riddell, who has been collecting the Polychaeta, reports the addition to the previous records for Port Erin of twenty-eight species. A note by Dr. Roaf, on his investigations on the secretion of the hypobranchial gland in *Purpura lapillus*, states that the purple-forming area of this gland is the site of formation of an adrenalin-like substance. The operations of the fish hatchery at the station have resulted in the liberation into the sea of more than eight millions of plaice larvæ and five thousand lobster larvæ.

The concluding portion of the report contains an account, by Prof. Herdman, of his plankton observations. Among the subjects to which he refers is the history of the spread of the diatom *Biddulphia sinensis*, which was probably introduced, in 1903, by some ship from the East into the mouth of the Elbe, whence it spread so that, by 1907, it had penetrated into the Baltic and extended to the English Channel, Norway, and the north of Scotland. This diatom was first observed at Port Erin in November, 1909; it appeared again, in more vigorous condition, a year later, and seems, therefore, to have become a well-established member of the plankton of our seas. Prof. Herdman also records some observations made during the last four years on the summer plankton of the Hebrides, which show that the plankton was of different types in different localities, but preserved a constant character in each; appended are some suggested explanations of the facts.

THE METHOD OF SCIENCE.[1]

SCIENCE governs human life by determining the conditions of existence and by furnishing the means of civilisation. Religion prescribes the motives, government formulates the customs of mankind, science fixes what we can do and how. If, at the present meeting, we appropriately emphasise the *rôle* of science, it does not imply that we belittle the ethical or social factors of civilised life, but answers the demand for a more just and general recognition of the actual importance of pure science.

We are so accustomed to the practical advantages that have followed from abstruse science, that we connect them

[1] From an address delivered by Prof. C. S. Minot as president of the Section of Physiology and Experimental Medicine of the American Association for the Advancement of Science, at Minneapolis, December 29, 1910.

with their source only by a distinct mental effort. The wonders of practical science have been recited so often that their reiteration has become tedious, and we no longer feel strongly impelled to felicitate mankind on the parlour match, the telephone, and the antitoxins, although we indulge at present in an unsubdued, excited anticipation of wonders to come, especially in the domain of medicine. Are we not all on the watch for the announcement of the cure for cancer, and vaguely for other new and astounding reliefs from disease? Such concentration of interest upon novel practical results is not wholly favourable to science.

It is true that a large amount of investigation is going on which aims to secure immediate practical results. In chemistry and medicine especially, the activity in the work of applied science is very great. This condition gives a powerful fresh reason for defending pure, abstruse science. Applied science always has been, is now, and probably always will be, distinctly subsidiary to pure science. The final justification of all scientific research is undoubtedly the power it creates for the use of mankind, but the power must be created before it can be used. A little study of the history of science should suffice to convince any reasonable mind that the command we possess to-day over nature is due to the labours of men who have almost invariably pursued knowledge with a pure devotion uncontaminated by any worship of usefulness. These devoted idealists have gathered the varied mighty harvests by which all men have profited, but the debt of gratitude to them is unpaid.

The pursuit of abstruse science needs to be encouraged. It is insufficiently esteemed. This doctrine ought to be emphasised on all suitable occasions, but especially before the section of experimental medicine. The people cry for relief from sickness, and their demand for prompt, useful discoveries is so urgent that there is danger in it, since it tempts medical investigators away from the fundamental inquiries, which, answered, will give great results, and seduces them to work exclusively at secondary problems, from the solution of which quicker, but smaller, results may be expected. Pure science is broad; it embraces all. Applied science is a congery of fragments, of isolated problems, which lack cohesion and are without any necessary connection with one another. It is easy to understand why students of applied science have seldom made great discoveries.

In fact, scientific knowledge will not be compelled. We have to take what knowledge we can get, and by no means can we get always what knowledge we want. Pure science adapts its undertakings to these rigid conditions, and works where the opportunity is best—not so applied science.

Compared with the growth of science, the shiftings of Governments are minor events. Until it is clearly realised that the gravest crime of the French Revolution was not the execution of the king, but the execution of Lavoisier, there is no right measure of values, for Lavoisier was one of the three or four greatest men France has produced.

Since pure science has been pre-eminent in the past, not only in furnishing useful knowledge, but also as a chief foundation of human progress, and is likely long to continue equally pre-eminent, it is well worth while to study the general principles by which original research is guided. No previous definite study of these principles is known to me, although I have searched not a little to find one. All that I have been able to discover are treatises on logic, the reading of which, most active investigators would, I fear, find tedious and unprofitable rather than helpful and inspiring.

It is my belief that the logical work of scientific men is usually well done, and is the part of their work which is least faulty. The difficulties and the majority of failures are due, it seems to me, to two chief causes, the first, inadequate determination of the premises, the second, exaggerated confidence in the conclusions. If I am right, the method of science is the result of the effort to get rid of these two causes of error.

We must recognise in starting that the expression "the method of science" means more than "logic," being far more comprehensive when rightly defined. We cannot alter the fundamental conditions of knowledge, for we are still unable to add new senses or improve the brain—although eugenics dreams of a future with such possibilities—nor can we change the nature of the phenomena. The same fundamental resources are available for daily life and for science. We must be clear in our minds on this point, in order to comprehend that the fundamental distinction of the scientific method is its accuracy. Such being the case, a broad examination of the method of science reduces itself to the study of the general principles of securing accuracy.

If you will examine frankly your own opinions and those of your acquaintance, you will, it may be presumed, quickly acknowledge that many, perhaps most, of the opinions are not of scientific accuracy. On the contrary, they are, to a large extent, mental habits and the result of the summation and averaging of impressions. We get along in ordinary life satisfactorily enough with opinions thus formed by summation. Most human opinions, even when they are merely imitative, originate in this way, and are correspondingly untrustworthy. If we seek to explain the fallibility of ordinary opinions and testimony, must we not attribute it to the absence of the detailed evidence and the consequent impossibility of verifying the testimony?

We are thus led to recognise the preservation of the evidence as the fundamental characteristic of scientific work, by which it differs radically from the practice of ordinary life. I venture, accordingly, to define the method of science as the art of making durable, trustworthy records of natural phenomena. The definition may seem at first narrow and insufficient, but I hope to convince you that it is so comprehensive as to be not only adequate, but also almost complete.

All science is constructed out of the personal knowledge of individual men. Science is merely the collated record of what single individuals have discovered. Accordingly, we must consider, first, the way in which the individual knowledges are recorded and collated. The process begins, of course, with the publications of the special scientific memoir in which the investigator records his original observations and makes known his conclusions.

It is interesting to note that our present standards for original memoirs have developed gradually. In Harvey's essay on the circulation of the blood, published in 1628, there are no precise data as to his observations. The author does not think it necessary to specify how he has laid bare the heart or how often he has repeated his observations. His descriptions of the beating heart are vividly realistic. He writes with conviction and authority. The reader is compelled to believe him. Harvey, however, does not provide information to facilitate repetition of his work—he offers little aid towards the verification of his results.

In a contemporary article we expect a presentation of all the data necessary to render subsequent verification by other observers possible. We further expect clear information as to the amount of material on which the observations were made, or the number of experiments on which the work is based. In other words, a modern investigator will hardly receive consideration for his researches unless he furnishes every aid he can to facilitate criticising and testing his results. This severe standard has been only gradually evolved, but is now stringently enforced in all departments of science, and is the response in our practice to our need of eliminating the purely personal factor. It would be advantageous if scientific authors, generally, viewed the obligation of providing for verification as an even more serious duty than it is esteemed at present. It might, indeed, be a wholesome practice to demand that every scientific article should contain a special section or paragraph on the means of verifying the result, for verification by *Fachgenossen* is second in importance only to discovery in the progress of science.

The conditions of scientific progress have changed greatly, though very gradually. Two hundred years ago the number of active investigators was small. This year there are at least ten thousand men of substantial ability carrying on original researches, consequently each theme is being worked at by several men, and the final outcome is the consequence of collaboration, which is none the less actual and effectual because it is unorganised, and is usually not formally designated as collaboration.

These conditions have rendered great men somewhat less

important than formerly. Science grows by the accretion of ideas. Now, a great man has, let us say, twelve new ideas, where a man of ability has one. If science gets twelve new ideas, it matters little whether they come from one man or from twelve. To a certain extent, numbers make a substitute for genius—but nothing probably will ever replace that type of great genius, to which we owe most, the man who has a great thought, which no one has ever conceived before.

The nineteenth century, in response to the new conditions which have arisen in its course, has added another new standard for scientific memoirs—they must include a conscientious consideration of recent and co-temporary related work. Now the second step in science-making, after recording the new original observations, so as to make them accessible to others, is the collation of these same observations into broad general results. The aim is to eliminate the personal factor and to impart the character of impersonal, absolute validity to the conclusions.

In addition to the original memoirs, science profits by a large number of publications, almost all of which are of modern, often of very recent, creation. Broadly speaking, their aim is to promote that collation which is begun in the original memoirs. Germany is the home of most of these undertakings, which are familiar to us under the names of "Jahresberichte," "Centralblätter," and "Ergebnisse."

We recognise in the present methods of recording and collating scientific discoveries many adaptations which are due, it seems to me, essentially to the mere increase in the number of workers. But though the methods are modified, the essential steps are the same: first, the record of the individual personal knowledge; secondly, the conversion of the personal knowledge by verification and collation into valid impersonal knowledge; thirdly, the systematic coordination and condensation of the conclusions.

A defect—perhaps the most serious defect of our education—arises from our failure to make our students appreciate vividly the fundamental fact that science is based on personal knowledge. Our students are allowed to graduate from college, for the most part, without any comprehension of this great truth. The best of them start forth with a high reverence for the library, the place of records, but quite unaware that a still higher reverence is due to those who, by being the first to observe unknown things, have founded the knowledge the records of which the library keeps.

The divergence between philosophy and science shows itself most conspicuously in the personal mental attitude which philosophy cherishes and science seeks to overcome. Philosophers still discuss philosophers and their systems, scientific men pursue impersonal knowledge with such ardour that they are apt to know little of the history of science.

The records which we have considered thus far are those which serve to make the discoveries of individuals available for others. So soon as the discoveries are properly collated and sufficiently verified, they become permanent parts of science. Many definitions of science have been given, and did time permit it might be profitable to quote some of them—but is it not sufficient to define science as *knowledge which has acquired impersonal validity?*

We must now attempt a general examination of the records, which are used primarily to help the original investigator, though often preserved to assist his successors. The simplest form of record is the preservation of the actual specimen. Scientific museums are essentially storehouses for such records. Most of them, to be sure, maintain public exhibitions, which interest, stimulate, and possibly instruct the public, but the precious part of their collections comprises the objects possessed, which have served for some original discovery. Scientific museums are very modern; nearly all those in America have been started within a few years.

The progress of science is marked by the advance in the art of making research records. We all admit, in other words, that the progress of science depends partly on the perfecting of old methods, but chiefly on the invention of new ones. Despite the enormous variety in their nature and aims, all our technical methods have this in common —that their real purpose is to yield us records. Our microscopes, spectroscopes, measuring instruments, and many another apparatus have indeed their primary scope in rendering possible observations which are impossible with our unaided senses. They enlarge our field of inquiry, and put precision within our reach. Yet their usefulness is conditioned upon their enabling us to make records which else would remain beyond our power. On the other hand, there is a still larger class of apparatus which are obviously designed to make records. What has been said concerning apparatus might be repeated concerning methods.

It is remarkable that the vast majority of methods and apparatus are contrived to furnish a visible result. Sight has long been acknowledged by science as the supreme sense. Perhaps the philosopher was right who asserted that nothing is really known until it is presented in a visible form. We biologists cannot deplore too frequently or too emphatically the great mathematical delusion by which men often of very great, if limited, ability, have been misled into becoming advocates of an erroneous conception of accuracy. Although I have expressed myself on the subject before, its importance justifies recurring to it. The delusion is that no science is accurate until its results can be expressed mathematically. The error comes from the assumption that mathematics can express complex relations. Unfortunately, mathematics have a very limited scope, and are based upon a few extremely rudimentary experiences which we make as very little children, and of which, probably, no adult has any recollection. The fact that from this basis men of genius have evolved wonderful methods of dealing with numerical relations should not blind us to another fact, namely, that the observational basis of mathematics is, psychologically speaking, very minute compared with the observational basis of even a single minor branch of biology. Moreover, mathematics can at the utmost deal with only a very few factors, and cannot give any comprehensive expression of the complex relations with which the biologist has to deal. While, therefore, here and there the mathematical methods may aid us, we need a kind and degree of accuracy of which mathematics is absolutely incapable. For our accuracy it is necessary often to have a number of data in their correct mutual relations presented to our consciousness at the same time, and this we accomplish by the visual image, which is far more efficient for this service than any other means of which we dispose. When we wish to understand a group of complex related details, such as an anatomical structure, we must see them, and if we cannot see them no accurate conception of the group can be formed.

With human minds constituted as they actually are, we cannot anticipate that there will ever be a mathematical expression for any organ or even a single cell, although formulæ will continue to be useful for dealing now and then with isolated details. Moreover, biologists have to do with variable relations, some of which, of course, can be put into mathematical form, but we find that even the simplest variations become clearer to us when presented graphically. The value to every student of science of the graphic method has been immense. Biologists can work to advantage with quantitative methods, we welcome the increasing use of measurements in biology, we welcome the English journal *Biometrika*, the organ of the measuring biologists—but none the less we refuse to accept the mathematical delusion that the goal of biology is to express its results in grams, metres, and seconds. Measurements furnish us with so-called "exact" records, but the aim of science goes beyond the accumulation of exact records to the attainment of accurate knowledge, and the accuracy of our knowledge depends chiefly on what we see. The practice of science conforms to this principle, the definite affirmation of which may prove of continuing advantage.

No class of records illustrates the value of sight in science more impressively than those made by instruments for registering the time factor. The kymographion invented by Carl Ludwig is the prototype of many apparatus. In them all, a succession of events, like heart beats, for example, together with marks showing the time, are so registered that they can be seen simultaneously, and thus readily compared. If no such apparatus were available, much of our most important scientific knowledge would

not exist. To deprive mankind of microscopes or telescopes would be hardly a more serious blow to science. We do not, of course, depend on our eyes for the notion of time—for the congenitally blind perceive time—but so soon as we wish to know accurately the relation of changing events to time intervals, we depend upon having them recorded in a visible form. It is the practical acknowledgment of the superiority of the eye as an agent to make clear the correlation of data.

Scientific men base their work upon a series of assumptions: first, that there is absolute truth, which includes everything we know or shall know; secondly, that we ourselves are included in this absolute truth; thirdly, that objective existence is real; fourthly, that our sensory perception of the objective is different from the reality. These conceptions constitute our fundamental maxims, and even when not definitely put in words they guide all sound scientific research. Metaphysicians find such maxims interestingly debatable; but science applies them unhesitatingly, and is satisfied because their application succeeds. Philosophy, ever a laggard and a follower after her swifter sister, has lately, and somewhat suddenly, termed the scientific habit of work pragmatism, and has taken up the discussion of it with delightful liveliness. Let us acknowledge the belated compliment and continue on our way.

The practical result of the four maxims has been that we further assume that all errors are of individual human origin, and that there are no objective errors. We make *all* the mistakes, nature makes none. To render the pursuit of new knowledge successful, our basic task is to eliminate error, or in other words to decide when we have sufficient proof. The elimination of error depends primarily upon insight into the sources of error, which, since methods of all sorts are employed, involves an intimate technical acquaintance with the methods, with just what they can show, with what they cannot show, and with the misleading results they may produce. In the laboratory training of a young scientific man, one chief endeavour must always be to familiarise him with the good and the bad of the special methods of his branch of science. Not until he thoroughly understands the character and extent of both the probable and the possible errors is he qualified to begin independent work. His understanding must comprise the three sources of observational error, namely, the variation of the phenomena, the imperfections of the methods, and the inaccuracy of the observer. The personal equation always exists, although it can be quantitatively stated only in a small minority of cases.

The history of science at large, the history of each branch of science, and the personal experience of every active investigator, all equally demonstrate that the greatest source of error is in our interpretations of the observations, and this difficulty depends, it seems to me, more than upon any other one factor; upon our unconquerable tendency to let our conclusions exceed the supporting power of the evidence. Since generalisation is the ultimate goal, we are too easily inveigled into assuming probabilities to be certainties, and into treating theories, and even hypotheses, as definite conclusions. Each generation of investigators in its turn spends much time killing off and burying older erroneous interpretations. The business is seldom accomplished by direct attack, for error perishes only in the light of truth, as micro-organisms are said to perish suddenly when struck by ultra-violet rays. Owing to the load of false theories, we work like a mental chain-gang, and are never unfettered. The handicap imposed by wrong hypotheses has always impeded the growth of science.

The multitude of such experiences, great and small, has gradually created among scientific men a special highly characteristic mental attitude. They regard the majority of the accumulated data and many of the inductions of science as correct. This is their estimate of the great body of information which, though personal in its origin, has been in the course of time so tested and verified that it is looked upon as established and secure. When Asellus in 1622 discovered the lymphatics, or so-called lacteals, of the mesentery, and demonstrated that they convey products of digestion from the intestine, his knowledge was his own, and at first his only. Since then the observations have been repeatedly verified, and of course extended, and all uncertainty has vanished from our minds. Similarly, in innumerable other cases reasonable impersonal certainty has been attained. Yet the investigator lives in an atmosphere of concentrated uncertainty, for he is convinced that at any time new data may turn up, and that all generalisations are likely to require modification. We might well adopt as our cry: Incredulity towards the known; open credulity towards the unknown.

We think of science as a vast series of approximations, and our task is constantly to render our approximations closer to absolute truth, the existence of which we take for granted. We use our approximations as best we may, treating them in large part and, at least for the time being, as if they were accurately true, yet meanwhile we remain alert to better them. This has long been the standard of scientific thought. It is the pragmatic attitude of mind, but its new name has not rendered it a novelty.

The pivot of all research is adequate proof. It would certainly aid science if some competent philosopher should make a study of the practice of investigators in the various branches of science sufficient to render clear the general principles by which investigators decide when a new observation or a new induction is sufficiently proven. If we follow the advance of research in any particular direction, we soon realise that there is a more or less definite standard of proof, which, though never clearly formulated, is none the less insisted upon, so that any paper which does not come up to this standard is subject to unfavourable criticism. Two elements of this standard we know, the first the elimination of the recognised sources of error, secondly, the repetition of the observations so that the constancy of the phenomenon is assured. We cannot do more than allude to this theme, which I must leave to the future and to a more competent mind to analyse and develop.

To sum up. The method of science is not special or peculiar to it, but only a perfected application of our human resources of observation and reflection—to use the words of von Baer, the greatest embryologist. To secure trustworthiness, the method of science is, first, to record everything with which it deals, the phenomena themselves and the inferences of the individual investigators, and to record both truly; secondly, to verify and correlate the personal knowledges until they acquire impersonal validity, which means, in other words, that the conclusion approximate so closely to the absolute truth that we can be safely and profitably guided by them. The method of science is no mystic process. On the contrary, it is as easily comprehended as it is infinitely difficult to use perfectly, and at its best the method supplies merely available approximations to the absolute.

We set science upon the throne of imagination, but we have crowned her with modesty, for she is at once the reality of human power and the personification of human fallibility.

THE CALORIC THEORY OF HEAT, AND CARNOT'S PRINCIPLE.[1]

THE caloric theory of heat as developed by Carnot in his famous "Reflexions on the Motive Power of Heat" (Paris, 1824) leads immediately to the correct solution of the relations between heat and motive power (energy or work) in all reversible processes, and appears to be in some respects preferable to the mechanical theory as a method of expression, because it emphasises more clearly the distinction, first clearly stated by Carnot, between reversible and irreversible transformations, and because it directly provides the natural measure of a quantity of heat as distinct from a quantity of thermal energy.

Carnot first introduced the method of the cyclical process in discussing the action of a heat engine, and showed that, in the ideal case, if there were no direct transference of heat between bodies at different temperatures, the transformations of heat and motive power in such a cycle were reversible. Assuming that it was impossible to

[1] Abstract of the presidential address delivered before the Physical Society on February 10 by Prof. H. L. Callendar, F.R.S.

imagine a heat engine capable of producing motive power perpetually without taking any heat from the boiler, he concluded that the quantity of motive power, W, produced from a given quantity of heat, Q, by means of a reversible engine, working between given temperature limits in a cyclical process, was the maximum obtainable, or that the efficiency must be independent of the agents employed, and must be a function of the temperature limits alone. He expressed this by the equation $W/Q=F(t)$, between finite limits o° and t° C., or by the equivalent equation $dW/dt=QF'(t)$ for a cycle of infinitesimal range, dt, at a temperature, t, where $F'(t)$ (generally known as Carnot's function) is the derived function of $F(t)$, and must be the same for all substances at the same temperature.

Applying the equation in this form to a gas obeying the law $pv=RT$, he showed that the heat absorbed in isothermal expansion from v_0 to v was given by the expression $Q=R\log_e(v/v_0)/F'(t)$, and that the difference of the specific heats at constant pressure and volume, given by the expression $S_p-S_v=R/TF'(t)$, must be independent of the pressure, and the same for equal volumes of all gases. These results were new, but were confirmed experimentally by Dulong five years later. Carnot showed, further, that if the ratio S_p/S_v was constant (as found by Gay Lussac and Welter, and assumed by Laplace and Poisson), both S_p and S_v must be independent of the pressure.

The results so far obtained by Carnot, including the description of his reversible cycle and the deduction of his fundamental principle, were independent of any assumption as to the nature of heat. Applying the assumption of the caloric theory, that the quantity of caloric required to change the state of a substance from (v_0, t_0) to (v, t) was the same by any reversible process, Carnot deduced that, if S_v was independent of the pressure, the function $F'(t)$ must be constant, $=A$. This assumes that heat is measured as caloric, and that temperature is measured on the scale of a gas, obeying the law $pv=RT$, and having S_v independent of the pressure, which is equivalent to the modern definition of a perfect gas. Putting $F'(t)=A$, he obtains for the work W produced from a quantity of caloric, Q, supplied at a temperature, T, in a cycle of finite range T to T_0, an expression equivalent to the following:—

$$W=AQ(T-T_0).$$

Carnot was unable to reconcile this solution with the imperfect experimental data available in his day, and particularly with the observation of Delaroche and Bérard, supported by Laplace's theory, that the specific heat of air, S_p, diminished with increase of pressure, which we know now, from the experiments of Regnault, to have been incorrect. He therefore made no serious attempt to apply the solution, and subsequent writers have apparently failed to observe that it is the correct final solution of the problem on the caloric theory. With our present knowledge, it is easy to see that this solution of Carnot's is also consistent with the mechanical theory, and contains implicitly all the relations of heat and work so far as they relate to reversible processes. The quantity, Q, of caloric remains constant in reversible expansion, such as is postulated by Carnot, when no heat is supplied. The work done is directly proportional to the temperature range $T-T_0$. The absolute motive power or equivalent work-value of a quantity of caloric, Q, supplied at a temperature, T, is the maximum work obtainable from a perfect gas (and therefore from any other substance whatever) when $T_0=0$, namely, AQT. The efficiency of the cycle with range T to T_0 is $W/AQT=(T-T_0)/T$. The external work done in the cycle is the difference of the work-values of the caloric supplied and rejected, a result which is readily extended to cycles of any form.

To complete Carnot's solution, it is necessary to inquire what happens to caloric in irreversible processes, such as friction, or the direct passage of heat from a hotter to a colder body. Carnot, as we see from his posthumous notes, had already, before his early death in 1832, arrived at the general conception of the conservation of motive power, and had planned experiments in which the motive power consumed in friction should be measured at the same time as the caloric generated. According to his theory, it would have been natural to assume that the motive power of the caloric generated at any temperature, namely, AQT, should be equal to the motive power consumed in friction. But he realised that further experimental evidence was necessary, which was first supplied by Joule.

A quantity of caloric is defined in Carnot's equation as measured by work done in a Carnot cycle per degree fall. The absolute unit of caloric, which may appropriately be called the *carnot*, is that quantity which is capable of doing one joule of work per degree fall. The mechanical equivalent of Q carnots at T abs. is QT joules. From Carnot's data, the work done in a cycle per gram of steam vaporised at 100° C. per degree fall is 0·611 kilogrammetres, or nearly 6 joules. The caloric of vaporisation is 6 carnots. Similarly, from Kelvin's data for the pressure required to lower the freezing point 1° C., the caloric of fusion of ice is 1·2 carnots. Since this definition is independent of calorimetric measurements, it may be employed in a calorimetric test, in which steam is condensed at 100° C. on one side of a conducting partition, while ice is melted at 0° C. on the other, to determine by direct experiment what happens when caloric falls irreversibly by conduction from 100° C. to 0° C. We know that for each gram of steam condensed, or for each 6 carnots supplied at 100° C., 540/79·5 grams of ice approximately would be melted, or 8·17 carnots of caloric would appear at 0° C. The quantity of caloric is increased in the proportion 373/273. The motive power of the caloric remains constant if no useful work is done. The increase of the quantity of caloric is the same as if the available motive power AQ(T−T) had been developed and converted into heat by friction at the lower temperature. Whenever motive power is wasted in friction, or "in the useless re-establishment of the equilibrium of caloric," a quantity of caloric equivalent to the wasted motive power is generated. The total quantity of caloric in an isolated system remains constant only if all the transformations are reversible, in which case the motive power developed exactly suffices to restore the initial state. In all other cases there is an increase of caloric. The old principle of the universal conservation of caloric, which is true only for reversible processes, must therefore be modified as follows:—"*The total quantity of caloric in any system cannot be diminished except by taking heat from it.*"

This principle, with various modifications to suit special cases (such as conditions of constant temperature, pressure, or volume), is immediately recognised as one of the most fruitful in modern thermodynamics. But it appeals more forcibly to the imagination of the student, if established, as roughly sketched above, by a direct investigation of the properties of Carnot's caloric.

The caloric theory is seen to be perfectly consistent with Carnot's principle and with the mechanical theory for all reversible processes. Caloric is the natural measure of a quantity of heat in accordance with Carnot's equation if we adopt the gas-scale of temperature. The only defect of the caloric theory lay in the tacit assumption, so easily rectified, that the ordinary calorimetric units were units of caloric. The quantity measured in an ordinary calorimetric experiment is the motive power or energy of the caloric, and not the caloric itself. If this had been realised in 1850, it would have been quite unnecessary to recast and revolutionise the entire theory of heat. Evolution might have proceeded along safer lines, with the retention of caloric, and the investigation of its properties, which are of such fundamental importance in all questions of equilibrium in physics.

Since Carnot's equation, $dW/dt=QF'(t)$, was adopted without material modification into the mechanical theory, and $QF'(t)$ remained simply a quantity of Carnot's caloric (though Q was measured in energy units and $F'(t)$ received the appropriate value J/T required to reduce energy units to caloric), it was inevitable that Carnot's caloric should make its reappearance sooner or later in the mechanical theory. It first reappears, disguised as a triple integral, in Kelvin's solution (*Phil. Mag.*, iv., p. 305, 1852) of the problem of finding the available work in an unequally heated body. The solution (as corrected later) is equivalent to the statement that the total quantity of caloric remains constant when the equalisation of temperature is effected reversibly. Caloric reappeared next as the

"thermodynamic function" of Rankine, and the "equivalence-value of a transformation" (Clausius, *Pogg. Ann.*, 93, p. 487, 1854). Finally, in 1865, when its importance was more fully recognised, Clausius (*Pogg. Ann.*, 125, p. 390) gave it the name of "entropy," and defined it as the integral of dQ/T. Such a definition appeals to the mathematician only. In justice to Carnot, it should be called caloric, and defined directly by his equation $W=AQ(T-T_0)$, which any schoolboy could understand. Even the mathematician would gain by thinking of caloric as a fluid, like electricity, capable of being generated by friction or other irreversible processes. Conduction of caloric is closely associated with the electrons, and the science of heat would gain, like the science of electricity, by attaching a more material conception to the true measure of a quantity of heat, as distinguished from a quantity of thermal energy.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The exhibition will be awarded at the beginning of October.

The Day Training College will be known in future by the title of "The Cambridge University Training College for Schoolmasters." This change is made to meet a suggestion from the Board of Education.

The subject selected for the Adams prize in 1912 is "The Theory of Radiation." The experimental scrutiny of the spectra of gaseous substances has amassed much knowledge, already expressed in semi-empirical formulæ, relating to the structure of spectra, whether composed of discrete lines or of bands, and also relating to the influence of various physical causes, such as the admixture of other substances, on the relative intensities of the lines. The nature of the magnetic influence on lines and bands which is exhibited in the Zeeman effect awaits closer investigation, and the classification of the lines of a spectrum which it suggests may afford further clues towards the assembling of those groups of lines which are possibly in some way components of one fundamental mode of vibration. A critical discussion of some of the problems of molecular dynamics which are associated with these phenomena is proposed. This discussion might proceed either from some hypothesis of structure of the molecules of matter, or from comparison, by way of analogy, with the properties of known types of vibrations. Questions relating to the constitution of natural radiant energy in statistical equilibrium might also come up for consideration. The prize is open to the competition of all persons who have at any time been admitted to a degree in this University. The essays must be sent to the Vice-Chancellor on or before the last day of December, 1912.

The first lists of candidates for the tripos examinations next term have just been issued. The numbers of names are as follows:—mathematical tripos, part i., 127, part ii., 53; classical tripos, part i., 108, part ii., 9; law tripos, part i., 60, part ii. and for LL.B. degree, 75; history tripos, part i., 129, part ii., 108; theological tripos, part i., 38, part ii., 17; natural sciences tripos, part i., 223, part ii., 44; mechanical sciences tripos, 46; moral sciences tripos, part i., 7, part ii., 1; mediæval and modern languages tripos, 55; Oriental languages tripos, 5; economics tripos, part i., 18, part ii., 16.

LONDON.—A revised syllabus in physics for the B.Sc. pass examination for internal students has been approved to come into force in 1912. Internal students will in future be required to satisfy the examiners in the practical as well as in the written part of an examination in a science subject.

Dr. A. D. Waller, F.R.S., has been appointed as a representative of the University on the governing body of the Imperial College of Science and Technology to fill the vacancy created by the resignation of the Right Hon. Sir Henry Roscoe, F.R.S.

A memorial from the Deptford Borough Council has been presented to the Senate asking that immediate steps be taken with a view to the establishment at Goldsmiths' College of a University College for South London with low fees, available for day and evening students.

The D.Sc. in geology has been granted to Arthur Wilmore, an external student, and the D.Sc. degree in chemistry has been granted to Arthur Clayton, an internal student of the Royal College of Science.

The second annual report of the Military Education Committee, which has been presented to the Senate, shows that the University contingent of Officers Training Corps has made good progress during the year. The strength on December 31, 1910, was 33 officers and 953 cadets, and an artillery unit armed with two 18-pounder field guns has been formed during the year. A list of eleven cadets who have proceeded to commissions in the Special Reserve, or Territorial Force, is included in the report.

A university studentship in physiology of the value of 50*l.* is open. Applications must be received by the principal on or before May 31.

OXFORD.—On March 7 Congregation took into consideration a further amendment to the "Faculties" statute, which would have had the effect of exempting the lectures given by professors and readers in the University from the control of their respective boards of faculty. The amendment was approved by several of the professors, but opposed by others, including Prof. Gotch, professor of physiology. On a division it was lost by 32 to 66. This will have the effect of giving power to the boards of faculty to exclude the lectures of professors and readers from the official list of lectures.

PROF. DAVID A. MOLITOR has resigned the chair of topographic and geodetic engineering at Cornell University, which he has held since 1908. He is returning to private engineering practice in the West.

THERE is about to be tried an interesting experiment in academic cooperation between North and South America. At the suggestion of the University of La Plata, Buenos Aires, Prof. W. J. Hussey is to spend six months of the year in the service of that University and six months at the University of Michigan, where he has occupied the chair of astronomy and held the directorship of the observatory since 1905.

WE learn from *Science* that the State appropriation for the Massachusetts Institute of Technology is to be increased. There is to be paid annually, for ten years, to the institute the sum of 20,000*l.*, from January 1, 1912, to be expended under the direction of the corporation for the general purposes of the institute; the institute will maintain forty free scholarships in addition to those maintained already. From the same source we find that Mr. Carnegie recently wrote to the trustees of the Carnegie Institute at Pittsburg that he is prepared to increase the endowment income 10,000*l.* or 20,000*l.* a year if it can be shown that any department is hampered from lack of funds. An old student, who wishes to remain anonymous, has given, our contemporary states, to Phillips Exeter Academy 3555*l.*, with which to complete the Wentworth mathematical fund of 10,000*l.*

THE Army Council has made a number of decisions regarding the regulations for admission to the Royal Military Academy and the Royal Military College, and those under which commissions in the Regular Army may be obtained through other channels of entry. The lower limit of age at which candidates are permitted to compete for admission to the Royal Military Academy will next November be reduced to 16½ years, and that at the Royal Military College will in June, 1912, be reduced from 17½ to 17 years. Eventually the upper limit of age for admission at both colleges will be 19 years. After March, 1912, no further examinations will be held by the Army Qualifying Board. The leaving certificate for Army purposes has been redefined, and for the future is to be a certificate which testifies to a certain standard of proficiency in the subjects stated, and is granted by certain bodies to candidates not less than 16 years of age who have attended a course of study at a school approved by the Army Council. For the future, a certain number of cadetships at the Royal Military College will be reserved each half-year for the nomination by the Army Council of

suitable candidates at recognised schools. To be recognised by the Council, a school must be inspected by an approved educational body and reported as fulfilling the necessary educational requirements, and maintain a contingent of the Officers Training Corps. A certain number of prize cadetships is to be awarded to successful competitors at each half-yearly examination for admission to the Royal Military Academy and Royal Military College with the view of encouraging a higher standard of education among candidates for commissions in the Army, and of reducing in the case of the better qualified candidates the expenses incurred.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. P. V. **Bevan**: The absorption spectra of lithium and cæsium. This paper gives an account of the continuation of work done on the absorption spectra of vapours of the alkali metals. Difficulty was found in obtaining tubes which were not acted on by lithium vapour, and this difficulty was never completely surmounted. By the use, however, of considerable quantity of lithium in a steel tube, the absorption spectrum was obtained, and twenty-seven lines of the principal series were observed. The measurements for the whole series are given in the paper, the lines from the tenth to the twenty-seventh being new. The paper further gives measurements of wave-lengths for the similar lines for cæsium. The series has been extended to include twenty-four lines, and remeasurements were made, as there was pointed out by Prof. Hicks some probable errors in former determinations. The two series for lithium and cæsium are compared with the formulæ suggested by Hicks, and it is found that the agreement of calculated and observed wave-lengths is exceedingly good, a slight change in one of the constants for cæsium being indicated.—Prof. P. V. **Bevan**: Dispersion in vapours of the alkali metals. This paper gives an account of measurements of the dispersion in rubidium and sodium vapours. The work is of the same character as that on the dispersion in potassium vapour described in the Proceedings of the Royal Society, A, 84, 1910. Dispersion curves for the rubidium vapour were obtained for the region of wave-lengths 6000 to 3000. Anomalous dispersion effects were observable at the first eight members of the principal series lines. These lines being pairs, interesting curves are obtained for the second and third pairs. The relative values of the constants in the Maxwell-Sellmeier formula are obtained, and similar conclusions drawn from them, as in the case of the paper already referred to concerning the numbers of atoms taking part in the absorption of light. Measurements of wave-lengths of the lines of the principal series are given, and these are shown to be in good agreement with the values calculated from the Hicks modification of the Rydberg formula. Similar measurements were made in the case of sodium. In this case the effects are not so large or so easily obtainable as in the cases of rubidium and potassium. Measurements were also made to see if any temperature effect could be detected in the ratios of the constants of the dispersion formula. These go to show that the ratios m_1/m_2, m_2/m_3, &c., where m_1/m_2, &c., are the constants corresponding to the first, second, &c., lines of the principal series, increase with increase of temperature. This result is what might be expected if the absorbing atoms are ordinary atoms to which corpuscles become attached, more complex systems corresponding to higher members of the series of lines in the spectrum.—J. **Kendall**: The ionic solubility-product. Previous investigations upon the simultaneous solubility in water of two substances containing a common ion have been confined to those cases in which the substances examined have been of the same type—*i.e.* either both strong or both weak electrolytes. In each case the experimental results have been considered to be consistent with the hypothesis of a constant ionic solubility-product, although, even in dilute solutions, the agreement is only approximate. The primary object of this research was to test the applicability of the theory to substances of opposite types, one strong and one weak electrolyte. Preliminary experiments showed that here also small divergencies were obtained. Finally, a series of experiments on all the possible types of combination of two electrolytes was carried out, first with dilute and afterwards with more concentrated solutions, in order to ascertain the cause of these divergencies and their bearing upon the solidity of the theory. The results obtained show that the mutual solvent actions of the two substances play an important part in the equilibrium. The general rule appears to be that two substances chemically similar in character give results in excess of theoretical, while with two chemically dissimilar a diminution is observed. In dilute solutions all divergencies are small, but fundamental, and in certain cases the amount due to each of the two substances is calculated. In the more concentrated solutions, where the solvent effect is greater, the three possible types of solubility curves are obtained and discussed, and it is found that in all cases experimental divergencies from values indicated by the constant solubility-product hypothesis can be fully accounted for by this solvent effect of the substances upon each other.—Dr. W. H. **Eccles** and H. **Morris-Airey**: Note on the electrical waves occurring in nature. The occurrence of a lightning stroke must, in general, give rise to either a solitary electric wave or a train of electric waves which will be propagated from the centre of discharge to unknown distances. These vagrant waves join with other natural electric phenomena to cause disturbances—technically called "atmospherics"—in the receiving circuits of wireless telegraph stations. Among these other phenomena may be mentioned charged hail or rain striking the air-wires and earth-air currents. The present communication describes an endeavour to determine the proportion of atmospherics of distant origin. The plan of attack was as follows:—One of the authors in London and the other in Newcastle arranged receiving apparatus just as for the telephonic reception of signals, and simultaneously listened at prearranged times, for atmospherics. A hand record of the time and intensity of each strong atmospheric was made on paper ruled to represent ten seconds of time per inch. By arranging the periods of observation to include the midnight time signals from the Eiffel Tower or from Norddeich, the time records of the two observers could be accurately coordinated. The observers exchanged copies of their records, and counted the number of marks coinciding in time. The results tend to show that about 70 per cent. of the atmospherics audible at two stations 270 miles apart are due to vagrant waves propagated from electrical discharges that take place at (possibly) very great distances.—Prof. E. A. **Schäfer** and K. **Mackenzie**: The Action of animal extracts on milk secretion.

Linnean Society, March 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. **Burr**: Dermaptera (earwigs) preserved in amber.—Miss Laura Roscoe **Thornely**: Report on the marine Polyzoa of the collection made by Mr. J. Stanley Gardiner, in the Indian Ocean, in H.M.S. *Sealark* during 1905.—W. M. **Tattersall**: The Mysidacea and Euphausiacea collected in the Indian Ocean during 1905.

Royal Anthropological Institute, March 7.—Prof. Gowland, F.R.S., in the chair.—Dr. **Duckworth**: Cave exploration at Gibraltar in September, 1910. The object of this research was to gain information on the spot as to the exact conditions in which prehistoric human remains occur on the Rock of Gibraltar. In addition to a general survey of the locality, two caves were explored. The first cave examined is in Forbes Quarry, whence the human cranium, so well known as the Gibraltar skull, was obtained in 1848. The cave in question proved very difficult to work, owing to the great density of ten successive stalagmite strata composing its floor. The latter was exposed over a considerable area, and at a depth of 4 feet 6 inches solid rock was always present. No animal remains could be detected. Since this excavation, Forbes Quarry has been almost completely filled, owing to the fall of many tons of rock from the heights above. The mouth of the cave is now hardly accessible. The second cave was at a considerable height (800 feet) above sea-level. The excavation yielded abundant evidence that it had been a resort of prehistoric man in the early Neolithic stage of culture. The conditions are best ex-

plained by describing them as a cave kitchen-midden. The evidence of human occupation includes the larger part of a human skeleton of the Cro. Magnon type, in addition to stone implements, sherds, and shell ornaments. The associated fauna is varied. To the list of such animals as have been recorded already, the following can now be added, viz.:—wolf, seal (Monachus), and almost certainly chamois, with certain birds and reptiles. Special attention was given to the identification of small mammalian bones with the view of ascertaining the presence or absence of Arctic rodent types; the latter were not identified. The author intends to seek further permission from the authorities to continue these researches at an early date.

Mathematical Society, March 9.—Dr. H. F. Baker, president, in the chair.—Prof. G. B. **Mathews**: The reduction and classification of binary cubic forms which have a negative determinant.—Major P. A. **Macmahon**: The theory of partitions.—Prof. A. E. H. **Love**: The theory of the transmission of earthquake waves.

CAMBRIDGE.

Philosophical Society, February 20.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Prof. **Nuttall**: The adaptation of ticks to the habits of their host. A survey of the present knowledge of the structure and biology of the Ixodoidea. The views expressed may prove of practical use in the study of the Ixodidæ.—Dr. **Cobbett** and Dr. **Graham-Smith**: The entry of bacteria into the lungs. Experiments made by the authors showed that, if *B. prodigiosus* be placed in the mouths of very young guinea-pigs, these micro-organisms may be found in the lungs a few minutes afterwards. The authors believe that the results obtained give the true explanation of the appearance of tuberculosis in the lungs of animals fed with tubercle bacilli in many experiments, and that they invalidate conclusions which have been drawn from such experiments as to the usual path of infection in pulmonary tuberculosis.—F. **Ransom**: The action of caffeine on muscle.—W. E. **Dixon**: Toleration to nicotine. One form of toleration to chemical substances is associated with their destruction and oxidation; the tolerance to alcohol and morphine are examples. In the case of nicotine, it has been found that normal animal tissues have the power to destroy a small quantity of the alkaloid. The tissues of animals which have been rendered tolerant to nicotine destroy a considerably larger amount. There is evidence to show that the destruction of the nicotine is not due to a chemical combination with the tissues, but that, on the contrary, it is brought about by ferment action.—Dr. **Cow**: The action of pituitary extract and adrenalin on peripheral arteries. Employing the method of O. B. Meyer, adrenalin constricted the peripheral arteries with the exception of the intravisceral portion of the pulmonary, the coronary, and cerebral arteries. The coronary and cerebral vessels were dilated, and the intravisceral portion of the pulmonary was unaffected. Pituitrin produced dilatation of the splenic, hepatic, and gastric arteries except along the first 3 or 4 mm. after their origin from the cœliac axis, in which part constriction was produced.—W. M. **Scott**: The action of ultra-violet rays on blood sera. Experiments were described showing that exposure to ultra-violet light destroyed the protective properties of immune sera in greater measure than it diminished their anaphylactic toxicity, and was therefore not of practical value for serum therapeutics.—E. A. **Owen**: The scattering of X-rays. Experiments have been made on the distribution of scattered X-rays. With hard rays, the distribution on the incident and emergent sides of the radiator is found to be the same. With softer rays the intensity is greater on the emergent side. This dissymmetry increases with the softness of the primary beam. It is also found that the dissymmetry alters somewhat with the thickness of the radiator.

PARIS.

Academy of Sciences, March 6.—M. Armand Gautier in the chair.—The president announced the death of van 't Hoff, correspondant in the section of mechanics, and gave a brief summary of his chief researches.—Armand **Gautier** and Charles **Moureu**: The examination of a new thermal water, presented as a prototype of a modern physico-chemical study of a mineral water. The methods of estimation of small quantities of lithium, manganese, antimony, bromine, fluorine, rare gases, &c. In addition to the ordinary physical properties, measurements of electrical conductivity, ionisation, and radio-activity were made. The radio-active emanation and the radium in the state of salt were estimated separately. Traces of antimony and tin were recognised in the chemical examination, and new methods are given for the determination of traces of lithium and fluorine.—A. **Haller** and Edouard **Bauer**: The action of ethyl chlorocarbonate on the sodium derivatives of ketones prepared by means of sodium amide. Isopropylphenylketone was converted into its sodium derivative by treatment with the theoretical quantity of sodium amide in presence of benzene; the slow addition of ethyl chlorocarbonate resulted in the formation, not of ethyl benzoyldimethylacetate, but of its enolic isomer. Other ketones of different types furnished similar products.—A. **Lacroix**: The radio-active minerals of Madagascar. A general description of the nature of these minerals and the conditions under which they are found. A detailed account of their analysis and radio-activity is reserved for a later paper. Complete analyses are given for samples of bloomstrandite, euxenite, samarskite, and fergusonite.—Ch. **Bouchard**: The toxic theory of sleep. Remarks on a recent paper on this subject by MM. Legendre and H. Piéron. The author notes that he published analogous experiments in 1886.—Edouard **Heckel**: A new plant from Madagascar giving aniseed oil. From the specimens examined, the author concludes that this plant is probably *Pelea madagascarica*. The parts of the plant examined contain from 4 to 5 per cent. of the essential oil, and the results of a physical and chemical examination of the oil are given.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1910. Observations were carried out on forty-seven days during the quarter. The results are given in tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Ch. **Galissot**: The selective absorption of the atmosphere. During 1909 and 1910 the author has repeated at the Observatory of Lyons the observations of Müller, using the Nordmann heterochrome photometer. Neither the observations of the author nor those of Müller can be represented on the usual hypothesis that the absorption depends only on the mass of air traversed.—Carl **Störmer**: The structure of the solar corona according to the Arrhenius theory.—D. **Eginitis**: Observations of the Faye-Cerulli comet made at the Observatory of Athens with the Gautier 50-cm. equatorial. Positions are given for December 3 and 23, and details of its appearance on those dates.—Robert **Jonckheere**: The discovery of new double stars at the Observatory of Hem.—Emile **Borel**: The structure of ensembles.—T. **Lalesco**: An integral equation of the Volterra type.—Louis **Roy**: The propagation of discontinuities in the motion of flexible wires.—J. **Paillet**, F. **Ducretet**, and E. **Roger**: A new method for the de-electrification of textile materials by means of high-frequency currents. Textile fibres during the processes of manufacture tend to become electrified. This causes separation of the fibres, leading to losses and deterioration of the product. The current methods of remedying this lead to the production of very moist and unhealthy atmospheres in the factory. The electrical method proposed by the authors is independent of the humidity and temperature, and gives better results in practice than can be obtained by the processes in ordinary use.—Pierre **Weiss**: An idea of Walther Ritz on band spectra. A discussion of some posthumous notes of Ritz.—F. **Leprince-Ringuet**: Formulæ relating to the transmission of heat between a fluid in motion and a metallic surface.—Ch. **Fery** and M. **Drecq**: The constant of radiation. A reply to some criticisms of MM. Bauer and Moulin on the method of calibration adopted in an earlier paper, and a description of a repetition of the experiments, with some modifications. The results completely confirm the determination published in 1909.—L. **Dunoyer**: The kinetic theory of gases and the realisation of a material radiation of thermal origin.—H. **Guilleminot**: The Sagnac radiations.—A. **Rosenstiehl**: Polymerised water and water of crystallisation. A reply to M. Lecocq de Boisbaudran.—J. **Boselli**: Reaction velocities in gas-liquid systems.—A. **Besson** and L. **Fournier**: The chlorobromides and

chloroiodides of silicon. The chlorobromides of silicon can be obtained in a pure state by the simultaneous action of hydrogen and bromine upon silicon tetrachloride under the influence of the silent discharge. The new method has the advantage of ensuring the absence of oxychlorides.—M. **Nanty**: The action of potassium bicarbonate upon magnesium chloride and upon soluble salts of magnesium in general.—G. **Darzens** and H. **Rost**: Some derivatives of butylcyclohexane. An account of the application of the Sabatier and Senderens method of adding hydrogen to butylphenol and its homologues.—André **Meyer**: The azo derivatives of phenylisoxazolone.—J. **Beauverie**: The hypothesis of the mycoplasma and the metachromatic corpuscles.—Pierre **Lesage**: The use of potash solutions for the recognition of the germinative faculty of certain seeds. It is shown that seeds that have lost their germinative faculty impart a colour to potash solution of a certain strength, whilst seeds still capable of germinating do not colour such solutions. As a means of rapidly sorting seeds, the author thinks this test may possess certain advantages.—Henry **Pénau**: The cytology of *Bacillus anthracis*.—A. **Marie** and Léon **MacAuliffe**: Anomalies in the dimensions of the ears in the insane.—L. **Spillmann** and L. **Bruntz**: The effect of certain pathological processes on the action of the leucocytes.—H. **Stassano** and L. **Lematte**: The possibility of preventing intact the agglutinated masses in bacteria which have been killed by the ultra-violet rays. The advantages of this means of sterilisation for the preparation of bacterial emulsions designed for sero-diagnostic purposes.—Pierre **Lesne**: The variations of feeding in the Coleoptera.—F. **Mesnil** and M. **Caullery**: Papillomatous neoformations in an annelid (*Potamilla torelli*). A description of a growth recalling the papilloma in vertebrates.—Edouard **Chatton**: *Paramyxa paradoxa*, a cnidosporidium without cnidoblast.—Carl **Renz**: The existence of some new Triassic deposits in central Greece.—P. and N. **Bonnet**: The existence of the Trias and the Mesojurassic in the *massif* of Kasan-Jalla (southern Transcaucasia).—L. **Cayeux**: The middle Miocene in the island of Crete.—Léon **Bertrand**: The structure of the western Pyrenees.—Louis **Fabry**: The three earthquakes of February 18 and 19, 1911. A discussion of the records of the seismograph of the Observatory of Marseilles.—The president gave an account of the legacy left by M. A. T. Loutreuil to the Academy of Sciences. This legacy amounts to 3,500,000 francs, and the testator's wishes as to the administration and application of the fund are given in full.

DIARY OF SOCIETIES.

THURSDAY, March 16.

Royal Society, at 4.30.—Gametogenesis of the Gallfly, *Neuroterus lenticularis*. Part II.: L. Doncaster.—The Action of the Venom of *Echis carinatus*: Sir T. R. Fraser, F.R.S., and Dr. J. A. Gunn.—Further Researches on the Development of *Trypanosoma gambiense* in *Glossina palpalis*: Colonel Sir D. Bruce, C.B., F.R.S., and others.—Spontaneous Cancer in Mice: Dr. M. Haaland.

Royal Institution, at 3.—Giants and Pygmies: Prof. A. Keith.

Linnean Society, at 8.—On the Brown Seaweeds of the Salt Marsh: Miss S. M. Baker.

Royal Society of Arts, at 4.30.—Education in India: C. H. A. Hill.

Institution of Mechanical Engineers, at 8.—Presidential Address: E. B. Ellington.

Royal Geographical Society, at 5.—Research Meeting. Names of the South Sea Islands: W. H. R. Rivers.—Geographical Monographs from Oxford. Salisbury District: L. M. Hardy.—Andover District: O. G. S. Crawford.

FRIDAY, March 17.

Royal Institution, at 9.—Water Supply: J. H. Balfour-Browne.

Institution of Civil Engineers, at 8.—The Production of Water-gas: Alwyne Meade.

SATURDAY, March 18.

Royal Institution, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, March 20.

Royal Society of Arts, at 8.—Applications of Electric Heating: Prof. J. A. Fleming, F.R.S.

Victoria Institute, at 4.30.—Prof. Hilprecht's newly-discovered Deluge Fragment: Dr. T. G. Pinches.

TUESDAY, March 21.

Royal Institution, at 3.—Explorations of Ancient Desert Sites in Central Asia: Dr. M. A. Stein.

Zoological Society, at 8.30.—On the Amphipod Genus Leptocheirus: Mrs. E. W. Sexton.—On Colour and Colour-pattern Inheritance in Pigeons: J. Lewis Bonhote and F. W. Smalley.—Notes on Marine Ostracoda from Madeira: Dr. G. Stewardson Brady, F.R.S.

Institution of Civil Engineers, at 8.—*Further discussion*: The Electrification of a Portion of the Suburban System of the London, Brighton and South Coast Railway: P. Dawson.

Royal Anthropological Society, at 8.15.—Physical Characters of Bushmen Past and Present: Dr. F. C. Shrubsall.

Royal Statistical Society, at 5.—Some Statistics of Japan: Charles V. Sale.

Mineralogical Society, at 5.30.—On Mr. Solly's Observation of Wiltshireite in 1903: Prof. W. J. Lewis, F.R.S.—Two New Minerals from the Binnenthal: R. H. Solly.—Notes on Cassiterite in the Malay Peninsula: J. B. Scrivenor.—Notes on the Occurrence of Dundasite in Derbyshire and Co. Galway, and of Bertrandite in Cornwall: A. Russell.—On Quartz-twinning: Dr. J. Drugman.—Crystallographic Notes: T. V. Barker.

WEDNESDAY, March 22.

Royal Society of Arts, at 8.—The Manufacture of Portland Cement: A. C. Davis.

Geological Society, at 8.—On some Mammalian Teeth from the Wealden of Hastings: Dr. A. Smith Woodward, F.R.S.—Some Observations on the Eastern Desert of Egypt; with Considerations bearing on the Origin of the British Trias: A. Wade.—Faunal Horizons in the Bristol Coalfield: H. Bolton.

THURSDAY, March 23.

Royal Society, at 4.30.—*Probable Papers*: A Theory of Asymptotic Series: G. N. Watson.—The Ionization of Heavy Gases by X-rays: R. T. Beatty.—The Variation of the Ionization with Velocity for the β Particles: W. Wilson.—The Causes of Absorption of Oxygen by the Lungs in Man: C. G. Douglas and Dr. J. S. Haldane, F.R.S.—The Influence of Planets on the Formation of Sun-spots: Dr. A. Schuster, F.R.S.

Royal Institution, at 3.—Giants and Pygmies: Prof. A. Keith.

Institution of Electrical Engineers, at 8.—Electricity Meters with Notes on Meter Testing: H. A. Ratcliff and A. E. Moore.

FRIDAY, March 24.

Royal Institution, at 9.—The Sidereal Universe: Sir David Gill, K.C.B., F.R.S.

Physical Society, at 5.—(1) A Sensitive Thermo Regulator; (2) Experiments on the Measurement of Electrolytic Resistances using Alternating Currents: Dr. H. F. Haworth.—(1) Oscillatory Currents in Coupled Circuits; (2) Some Radio-telegraphic Apparatus in Use at the City and Guilds (Engineering) College: Prof. G. W. O. Howe.

Institution of Civil Engineers, at 8.—The Uses of Chemistry in Engineering: James Swinburne, F.R.S.

SATURDAY, March 25.

Royal Institution, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 23, 1911.

A CRITICISM OF THE DARWINIAN THEORY.

The Mutation Theory. Experiments and Observations on the Origin of Species in the Vegetable Kingdom. By Prof. H. de Vries. Translated by Prof. J. B. Farmer and A. D. Darbishire. Vol. ii., *The Origin of Varieties by Mutation.* Pp. viii + 683. (London: Kegan Paul and Co., Ltd., 1911.) Price 18*s.* net.

THE first volume of Prof. de Vries's great work was devoted in the main to an account of the results of the experimental cultivation of an *Œnothera* of uncertain origin, and of the conclusions he deduced from them. The second volume is more general in its scope, and is in effect a criticism of the Darwinian theory. The two might conveniently have been published in the reverse order. That, at any rate, will be found the best way to read them to get a clear idea of the author's point of view.

It is remarkable that pangenesis, the part of Darwin's theory which was received with least enthusiasm at the time of its publication, now almost overshadows all the rest. As Strasburger remarks:—

"Darwin's idea that invisible gemmules are the carriers of hereditary characters, and that they multiply by division, has been removed from the position of a provisional hypothesis to that of a well-founded theory."

De Vries thinks that the phenomena of variability and mutation follow deductively. And for this he claims the support of Darwin himself, who points out ("Variation," ii., 396), "on the hypothesis of pangenesis that variability depends on at least two distinct groups of causes":—(i) when the gemmules are unmodified, but deficient or superabundant, or are rearranged, or become active after being dormant; (ii) when they are modified through changed conditions. The former, Darwin thought, explained "much fluctuating variability"; the latter, the appearance of "new and changed structures." It is worth notice that Darwin uses here the word "mutation," but only apparently in the algebraic sense of permutations of the gemmules.

It is interesting to compare with Darwin's conclusion the form in which de Vries restates it in terms of his own views. I have inserted for clearness the corresponding numbers:—

"(i) Numerical changes of the pangenes are . . . the basis of fluctuating variability. Changes of the position of the pangene in the nucleus lead to the retrogressive and degressive mutations; (ii) whilst to account for progressive mutation we must assume the formation of new types of pangenes" (p. 645).

To de Vries, "fluctuating variability is a function of nutrition." It is also "linear, and oscillates only in a plus and minus direction." Mutation, on the other hand, "necessarily assumes a variability in all directions." It seems abundantly clear that "fluctuating variability" has by no means the same meaning to Darwin and to de Vries. It must be explained that in retrogressive mutation, characters become latent; in degressive, latent characters become active (p. 72).[1] De Vries states (p. 56) that

"one of the chief objects of the book is to show that ordinary or fluctuating variability does not provide material for the origin of new species."

But if it is merely a case of an individual organism being a little better or a little less nourished, I do not know that I should disagree. Darwin, however, would certainly not have agreed that ordinary variability was linear, or that, seeing he traced its cause to "changes of any kind in the conditions of life," that it was dependent exclusively on nutrition. The conditions throughout a population can never be so uniform that some amount of fluctuating variability is not excited. But if they are constant on the average, there is no resultant selective action. Thus the flora of Egypt has remained stable since at least the date of the Trojan war.

De Vries is extremely anxious to make Darwin responsible for the mutation theory. "It was Darwin who first attempted in various cases to distinguish between" mutability and variability. It is quite true that Darwin distinguished between the multiplication or reshuffling of his pangenes and their modification. But there is no warrant for asserting that he thought the former played no part in the origin of species. He assumed that "variability of every kind is directly or indirectly caused by changed conditions of life" ("Variation," ii., 255). Without variation, "natural selection can do nothing." All that he conceded was that variation might have a considerable range. But he was far from rejecting the efficiency of fluctuating variability. "Under the term 'variations' it must never be forgotten that mere individual differences are included" ("Origin," sixth edition, p. 64); "natural selection is daily and hourly scrutinising, throughout the world, the slightest variations" (*l.c.*, p. 65).

Another misconception, for which, however, de Vries is not responsible, is that Darwin's theory of pangenesis ultimately led him to a modified acceptance of Lamarckism, *i.e.* that new structures might arise in direct response to the environment. De Vries himself would not accept this. In Darwin's view, the modified pangenes would simply supply material for more ample variation, but natural selection would still determine the result.

De Vries is convinced, nevertheless, that Darwin was at heart a mutationist, and that his belief in discontinuous variability "under Wallace's influence gradually shifted into the background." There seems here to be a double misconception, which it is not difficult to clear up. Darwin, writing to Wallace in 1869, said:—

"I always thought individual differences more important than single variations, but now I have come to the conclusion that they are of paramount importance, and in this I believe I agree with you" ("Life and Letters," iii., p. 107).

It is clear that by individual differences he means fluctuating variability. He was preparing at the time

[1] This seems explicitly stated; I cannot reconcile it, however, with the equally explicit statement on p. 576, where the meanings of progressive and degressive appear to be interchanged.

E

the fifth edition of the "Origin," and in this there appears a passage of which it is sufficient to quote the first sentence:—

"It may be doubted whether sudden and great deviations of structure, such as we occasionally see in our domestic productions, more especially with plants, are ever permanently propagated in a state of nature" (p. 49).

But, as explained on p. 104, it was Fleeming Jenkin, and not Wallace, who led him to minimise the importance of "single variations, whether slight or strongly marked"; and as these are mutations, Fleeming Jenkin's argument cuts to the root of de Vries's theory.

But the real divergence between Darwin and de Vries is not so much as regards variability, but selection, the importance of which the latter consistently minimises. To Darwin, variability of any kind merely supplied the field in which selection works, and "sinks to quite a subordinate position in comparison." With de Vries it is exactly the opposite. "Specific characters do not arise by selection." The combinations of characters which arise from sexual reproduction are, however, subject to it. With respect to adaptations, which is the crucial point, de Vries speaks with a more uncertain voice than in his "Plant Breeding." "Everything points to the conclusion" that mutation "will explain adaptations just as completely, or, rather, just as incompletely," as natural selection acting on fluctuating variability. This is a cryptic utterance at best. But if natural selection cannot produce specific characters, it cannot endow them, except at haphazard, with survival-value; in that case, its inability to account for adaptations seems a necessary consequence. He finally sums up his position:—

"I willingly admit that almost anything can be squared with the theory in a very plausible way; . . . but this is not science."

Some of us think that it is, and there we must leave it.

De Vries has devoted immense labour to the investigation of the cases, not infrequent, where seedlings occur with more than two cotyledons. Two is a reduced whorl, and a whorl may be explained as due to the suppression of internodes. The number of leaves in a whorl is often variable, though seldom so in the case of opposite leaves; this is in accordance with the principles of the "repetition of similar parts." That two cotyledons should be the rule may well be adaptive, seeing that they have to be packed in the seed. That there should occasionally be more is a not improbable mutation. It is interesting to note that de Vries entirely failed to fix tricotyly by selection. Nor is tricotyly, although it appears to be not uncommon, often followed by trimerous leaves. De Vries has been more fortunate than I have been with the sycamore, as he raised two high trees with "branches in trimerous whorls." He says nothing about the leaves. I signally failed in raising a number of tricotyledonous seedlings; in the third year they all reverted to the opposite-leaved arrangement. And I have only come across a single case of the wild maple with trimerous leaves. This serves as an illustration, if one were wanted, of how little survival-value mutations possess in nature.

There can be no doubt that what we want is a purely empirical study of the variation under artificial but precise conditions of some clean-cut species free from any suspicion of hybrid origin. It would have to be done on a considerable scale, and as it would have to extend over a long period of years it would be a tedious and laborious business. I have some hopes that it may be undertaken in America. The horticultural papers are now full of what is taking place with *Primula obconica*, which from a condition of stability has passed into one of high variability. But, as de Vries very justly remarks, the available records in such cases "lack precision." But he arrives at the interesting conclusion that

"in horticulture . . . mutations are largely of the retrogressive or degressive kind. Discontinuous formation of species on the progressive line is much rarer" (p. 602).

Here species is used in the de Vriesian, not the Linnean, sense. The meaning, I take it, is that latent characters become active or the reverse. On an earlier page (p. 4) he seems to imply that all the cultivator can do is to evoke latent characters. "The first condition necessary for raising a novelty is to possess it."

Some fifteen years ago I made a careful study of what could be ascertained as to the cultural evolution of *Cyclamen latifolium*. I may state the conclusion, which I confess I was not prepared for:—

"The general tendency of a plant varying freely under artificial conditions seems to be atavistic, *i.e.* to shed adaptive modifications which have ceased to be useful, and either to revert to a more generalised type or to reproduce 'characters which are already general in other members of the same group.'"

As might have been expected, this had not escaped Darwin, from whom ("Origin," sixth edition., p. 127) I had quoted the concluding words of the sentence.

De Vries still maintains the singular distinction which he draws between cultural variation in horticulture and in agriculture; perhaps on the Continent the two arts are more distinct than with us, where it can hardly be maintained. "Horticultural varieties are generally constant" (p. 76). Agricultural races "remain dependent on continued selection, and do not really become constant" (p. 422).

The Darwinian theory rests on a number of converging lines of argument, and derives its probability from their cumulative force; just as in a law court each branch of evidence may be slender in itself, yet the conclusion to which they all point has a higher degree of probability than any one taken separately. De Vries's attack on natural selection, I must confess, would not shake my faith even if I found it more convincing than I do. But he is entitled to the merit, which he justly claims for himself, of having probed variability by a rigorous experimental method. It is much to be wished, but scarcely to be hoped, that others will follow him in his lifelong devotion to so laborious a research.

W. T. THISELTON-DYER.

MOVEMENT OF MOLECULES.

Brownian Movement and Molecular Reality. By Prof. M. Jean Perrin. Translated from the "Annales de Chimie et de Physique," 8me Series, September, 1909, by F. Soddy, F.R.S. Pp. 93. (London: Taylor and Francis, 1910.)

THIS small volume of ninety-three pages is a translation by Mr. F. Soddy, F.R.S., of a memoir published by Prof. J. Perrin in the *Annales de Chimie et de Physique* in September, 1909. In this paper, Prof. Perrin gave a detailed account of his work upon the distribution in fluids of small particles, which show the Brownian movement, and the bearing of these results on the kinetic theory of matter. An interesting survey is first given of the historical development of this subject. The English naturalist, Brown, directed attention in 1827 to the fact that small particles suspended in liquids were always in a state of rapid but irregular movement. Comparatively little notice was paid to this observation until 1889, when Gouy showed that the Brownian movement could not be ascribed to temperature differences, but was a persistent effect which was probably a necessary consequence of the kinetic theory of matter. Since that time a large amount of interesting work has been done, especially by Continental workers, to throw further light on the magnitude and nature of the Brownian movement.

After a brief account of the kinetic theory of matter and its application to the determination of the dimensions of atoms, Perrin gives a full description of his own experiments. Using an emulsion of gamboge and of mastic, he was able to determine the distribution in liquids of nearly equal granules, the diameter of which in different experiments varied between $0{\cdot}1\mu$ and μ ($\mu = 1/1000$ millimetre). By counting the number of granules at different levels by means of a high-power microscope, he found that the concentration of uniform granules decreased in an exponential manner with the height, in the same way as barometric pressure due to our atmosphere decreases with the altitude. The diameter of the granules was determined by direct weighing, and also by means of the formula of Stokes. From the data thus obtained, he has shown clearly that these granules distribute themselves exactly like a gas of very high molecular weight. It follows from this that each of these granules has the same kinetic energy of movement as a molecule of any gas or liquid at the same temperature. This is a very important deduction, for it shows that the law of equipartition of energy in all probability holds, not only for single molecules, but for granules containing many millions of molecules. From the experimental data, it is not difficult to deduce directly the numerical value of Avogadro's constant, *i.e.* the number of molecules in one cubic centimetre of any gas at standard pressure and temperature. The determination of this constant allows us at once to deduce the mass of any molecule, and also the value of the fundamental unit of charge carried by the hydrogen atom.

The experiments of Perrin are highly ingenious and interesting, and throw much further light on the behaviour of these granules. By examining some large granules of diameter, about 13μ which contained an inclusion visible in the microscope, he has been able to show that a particle, in addition to a slow Brownian movement, exhibits a spontaneous irregular rotation, and that the mean energy of this rotation is about equal to the mean energy of translation, thus establishing another deduction from the law of equipartition of energy.

In the last few years a number of methods have been developed for the determination of atomic constants, and a brief account of these is given at the end of the volume. It is of interest to compare the values obtained by Perrin with those obtained by other observers by entirely distinct methods. It is simplest to compare the results in terms of the value deduced for the charge e carried by a hydrogen atom. Perrin finds $e = 4{\cdot}1 \times 10^{-10}$ electrostatic units, while Rutherford and Geiger, from their counting experiments, found a value of $4{\cdot}65 \times 10^{-10}$. Recently Millikan, as a result of an admirable series of experiments on small drops of oil, has found a value equal to $4{\cdot}90 \times 10^{-10}$. In the course of his work, Perrin made special experiments in order to test the validity of the application of Stokes's formula for determining the diameter of a globule by its rate of fall, and concluded that it held accurately over the range of diameters of granules employed in his experiment. On the other hand, Millikan finds that Stokes's rule is not valid for small particles, and that the error becomes considerable for particles of diameter about 2μ, which is about the diameter of the granules used by Perrin in his most accurate series of experiments. The deviations from Stokes's law observed by Millikan are in general agreement with the conclusions recently deduced by Cunningham as a result of a mathematical investigation. If Millikan is correct, the size of the granules deduced by Stokes's method requires correction, and this would tend to bring the value of e found by Perrin in closer accord with that of Millikan. It seems possible, also, that the apparently large variations observed by Ehrenhaft in the value of the fundamental charge carried by very small particles, visible in the ultra-microscope and showing large Brownian movement, may be due to the failure of Stokes's formula for very small particles.

The questions discussed in this volume are of great interest and importance in molecular physics, and the reader cannot fail to be impressed by the remarkable advances which have been made in recent years in showing the validity and essential reality of the kinetic theory as an explanation of the properties of matter.

The work of translation is on the whole well done, and the vigorous style of the author is retained. The translation is in a few cases somewhat peculiar. For example, on p. 5, "Le mouvement brownien . . . persiste la nuit, *dans un sous-sol*, à la campagne," is translated, "The Brownian movement . . . persists equally, for example, at night on a *subsoil* in the country." Again, on p. 8, "nous *constatons* un équilibre" is given "we *establish* an equilibrium."

Mr. Soddy has done a valuable service in bringing to the attention of the general and scientific reader the very interesting and clearly written account of this subject given by Perrin.

E. R.

MEDICAL BIOLOGY.

Biology, General and Medical. By Prof. J. McFarland. Pp. 440. (Philadelphia and London: W. B. Saunders Co., 1910.) Price 7s. 6d. net.

PROF. McFARLAND tells us in his preface that "medical science is, in fact, a branch of biology, and should be studied as such." With this opinion we heartily agree, and we were fully prepared to find that the present volume would supply a long-felt want in demonstrating the importance of biological studies from the medical point of view. We still believe that the author has succeeded in doing this, but he has also succeeded in demonstrating the fact that a medical man is not always the most trustworthy authority on biological questions. The plan of the book is interesting, and, to some extent, original, commencing very appropriately with the cosmical relations of living matter and ending with a chapter on senescence, decadence, and death; and the author has successfully avoided the pitfalls of the type-system. Nevertheless, we can hardly share his somewhat curiously expressed hope "that the writing will not be found too technical to be beyond the comprehension of any intelligent reader."

The work is largely a compilation and is of a curiously mixed character, derived partly from text-books—some of a very elementary character—and partly from highly technical writings of a more or less controversial nature. For elementary zoological facts the author appears to have relied largely upon Masterman's "Elementary Text-book of Zoology," and Galloway's "First Course in Zoology," from which numerous illustrations are borrowed. The "New International Encyclopædia" has supplied a superfluity of information upon parasites, arranged zoologically, but we should be sorry to attribute responsibility for the author's statements to any of the works mentioned.

The theory of heredity is treated mainly by means of copious quotations from Herbert Spencer, Darwin, Galton, Weismann, and Adami. The amount of space devoted to the complicated lateral chain theory of the last-named author seems quite out of proportion to that given to other subjects.

We are obliged in justice to our readers to point out that the work contains numerous inaccuracies and misleading statements. Thus, for example, the shell of a tape-worm egg is described as a cell-wall; flagella and cilia are described as rigid protoplasmic threads; the shells of Foraminifera and Radiolaria are said to "find their homologues in the dermal coverings, the limbs, and fins, &c., of the higher animals"; the medusa of Obelia is said to have a water-vascular system, and so on. On p. 103 we are told that the germinal cells have twice the number of chromosomes possessed by the somatic cells, and our astonishment at this statement is only partially abated when we come to p. 189, and find that the author is referring to the doubling of the number of chromosomes which is supposed to take place in the maturation of the germ-cells prior to reduction, and fully realises that the actual gametes have only half the somatic number.

It is, perhaps, of no great consequence to the general reader or to the medical man if the sponges are defined as "characterised by many incurrent openings and only one excurrent opening. Axially symmetric. Sexually reproductive," but this diagnosis is so strikingly inadequate, and to some extent even incorrect, that it might just as well have been omitted, as might that of the arthropods, which are simply defined as "jointed animals." Moreover, it is always possible that the book may find its way into the hands of a student preparing for examination.

In the chapter on the origin of life the author suggests (or borrows the suggestion, it is not quite clear which) that the power of reproduction may be "only characteristic of such forms as shall have already evolved to a certain point." The possibility of organic evolution without reproduction is, we must confess, a new idea to us, and one upon which we do not think, with the author, that "it may not be unprofitable to speculate."

We can only hope that the more especially medical chapters, dealing with blood relationship, infection and immunity, will be found less open to criticism at the hands of medical readers.

A. D.

GEOLOGICAL ESSAYS.

Outlines of Geologic History, with especial reference to North America. A Series of Essays involving a Discussion on Geologic Correlation presented before Section E of the American Association for the Advancement of Science, in Baltimore, December, 1908. Symposium organised by B. Willis; compilation edited by R. D. Salisbury. Pp. viii+306. (Chicago: University of Chicago Press; London: Cambridge University Press, n.d.) Price 6s. net.

SOME of the best qualified geological writers and workers in America, including Dr. F. D. Adams from the Dominion of Canada, have here brought together their views on the correlation of stratified deposits. The series of essays was originally published in the *Journal of Geology*, and forms a text-book of North American stratigraphy, embodying results up to December, 1908. It is illustrated by Mr. Bailey Willis's "paleogeographic maps" of North America, which are a little difficult to read in their black and white shaded form. Our ignorance of what lies beneath the oceans probably gives a false impression of fixity to the continental boundaries in many cases.

The terminology used has been left to the various authors, so that we may welcome Mr. Willis's retention of "Cambrian" as against Mr. Grabau's "Cambric." Prof. Salisbury, as editor, points a warning finger towards Mr. Grabau's preferences on p. 44; but he is unable to save us from the "Beekmantownian" representative of the "Lower Ordovicic." Should not, by the by, the correct translation of the French "Plaisancien" be, not Prof. Osborn's "Plaisancian" (pp. 216 and 262), but either "Placentian" or "Piacenzan"?

We have the benefit of the views both of Dr. Adams and Prof. Van Hise as to pre-Cambrian classification. The former urges that the break between the Middle and Upper Huronian in America is at least

as important as that between the Keewatin and the Lower Huronian. Hence he is forced to oppose the division of the pre-Cambrian rocks into Archæan and Algonkian only. The early Palæozoic faunas fall naturally to the care of Dr. C. D. Walcott, who interestingly describes the oldest known Cambrian beds, those of south-western Nevada and eastern California (p. 31). In *Nevadia weeksi*, referred at first to Holmia, he recognises a form of trilobite "more primitive than such forms as *Olenellus thompsoni* (Hall) and *Holmia bröggeri* (Walcott.)" This phrase reminds us of the dangers that lie in wait for the palæontologist. Seeing that Olenellus was once regarded as expressing the decadence of the Paradoxides type, may not this suggestion of primitiveness arise from the fact that the Olenellus fauna occurs in California 5000 feet above these interesting strata?

Mr. Grabau carries on the correlation to "Devonic time," in a paper involving considerable labour. In Mr. Girty's essay on the Pennsylvanian, we notice (p. 125) one of the special points provided for us by America, viz., the occurrence of beds with *Productus giganteus* in California, which can be correlated more easily with the Carboniferous Limestone series of Europe than with the eastern Mississippian (Lower Carboniferous) series of America. Mr. Girty believes that none of the Upper Carboniferous faunas of North America are truly of fresh-water origin. Even the Appalachian facies (p. 128) with Naiadites, containing as it also does Lingula and "Aviculipecten," must at any rate imply brackish water.

It is hardly profitable to indicate isolated passages of interest in a book so full of condensed and well-ordered information. As examples, we may mention in conclusion Mr. White's sketch of the rise of the Devonian flora (p. 140), with its hint of Archæopteris prevalent in the upper series throughout the world; Mr. Williston's account of the faunal relations of early vertebrates; and Prof. Osborn's "correlation of the Cenozoic through its mammalian life." Though primarily intended for the specialist, these essays will do much to bring new life into the teaching and writing of British geologists who are willing to look beyond the seas. G. A. J. C.

THE ANALYSIS OF SYNTHETICAL DYES.

Tests for Coal-Tar Colours in Aniline Lakes: A Review of the Coal-Tar Colouring Matters generally used in the Lake Industry, and their Behaviour with Distinct Chemical Reagents. By G. Zerr. Authorised English edition by Dr. C. Mayer. Pp. xii+230. (London: C. Griffin and Co., Ltd., 1910.) Price 10s. 6d. net.

THE complex nature, as well as their ever-increasing number, render the analysis of synthetical dyes no easy matter. The work before us endeavours to fill a vacant gap in analytical literature, dealing as it does with the detection of a large number of these compounds in aniline lakes.

The book is divided into two parts.

Part i. takes account of the lakes which may be prepared from more than three hundred coal-tar colours. The author's experimental results obtained by a study of the action of selected chemical reagents (caustic soda, sulphuric acid, and stannous chloride in hydrochloric acid), and also of solvents (hot water, alcohol, and acetic acid) on these lakes, are arranged in columns, thus forming a series of tables, which comprise the greater part of the book. More than four hundred lakes are considered, and their behaviour towards sunlight, turpentine oil, and varnish is also mentioned in these lists.

Part ii. indicates the methods of recognising the various coal-tar colours in the lakes. Here also we have a number of tables which are really analytical schemes deduced from the results obtained in Part i., and containing sufficient details to explain their use. We have repeated some of the experiments mentioned in Part i. and have found them satisfactory. The author himself in Part ii. gives us three detailed examples of analysis, which may well serve as models in the investigation of lakes containing one or more colouring matters. The book will no doubt prove a trustworthy guide to those engaged in the analysis of lakes, and also to others who wish to enlarge their experience in the identification of synthetical dyes. Its utility, however, may be enhanced by the addition of a standard colour chart, which will more definitely explain column iv. of Part i., and by a supplementary column (in Part i.), which may include, whenever possible, the constitutional formulæ and systematic names of the various coal-tar colours mentioned by the author, together with any references relating to patents. The translator has done his part well, bringing the work up to date.

It is to be regretted that the translator, before issuing the book, had not worked out a similar table of tests for the coal-tar colours which are manufactured by English firms, as in its present form it distinctly tends to encourage the use of coal-tar colours made abroad as against those made by our own manufacturers.

DOMESTICATED ANIMALS.

Domestic Animals and Plants: A Brief Treatise upon the Origin and Development of Domesticated Races, with special Reference to the Methods of Improvement. By Prof. E. Davenport. Pp. xiv+321. (Boston, New York, Chicago, and London: Ginn and Co., n.d.) Price 5s. 6d.

THIS volume, we are told in the preface, is intended primarily for high and normal schools in the United States, and also appeals more specifically to the general student. Consequently, it is of the utmost importance that the information it contains should be thoroughly trustworthy. A survey of the sections devoted to groups of animals with which I happen to be more particularly acquainted shows, however, that this is very far, indeed, from being the case.

Take, for example, the statement on p. 96 that all the varieties of domesticated pigeons "have been bred within historic times from the single primitive form, the wild or passenger pigeon." That, in this astounding statement, the author has not by accident written passenger pigeon in place of blue rock, is manifest by the fact that a figure of the former bird is given on

p. 93, with a legend to the effect that it is the parent form. Apparently Prof. Davenport is unaware that the passenger pigeon belongs to a genus apart from the one including the blue rock and domesticated breeds.

The author's want of knowledge is, perhaps, still more conspicuous in the section on cattle and sheep (pp. 219–30), where blunders occur in profusion. In the legend to the figure of an Indian buffalo, on p. 218, we are told, for instance, that this is the only kind of buffalo, but that the name is often applied to the European (as well as to the American) bison. The gayal is stated on p. 221 to be "an intermediate between the domesticated and the wild cattle of the Indian type"; but even that statement is outdone on p. 223, where we are told that if the domesticated cattle of Africa and Asia were to die out, there would be no difficulty in replacing them from wild stocks! Where the author proposes to find a wild ox in Africa, I do not know; but he apparently does not realise the difference between a buffalo and an ox. After this it is not surprising to find the revival of the theory that white park cattle (which are stated to occur "at Chillingham in southern Scotland, and Chartley and Cadzow in southern England") represent the ancestral colour of the wild ox. Neither is it startling to find it stated (p. 228) that the Armenian wild sheep inhabits the islands of the Mediterranean, that the Cyprian wild sheep has more than two horns (p. 230), and that "the musk-ox stands between the cattle and the sheep" (p. 229).

With these and other blunders in a couple of sections, Prof. Davenport's volume can scarcely be recommended as a trustworthy guide to youth in search of information.

R. L.

POPULAR SCIENCE.

The Autobiography of an Electron; wherein the Scientific Ideas of the Present Time are explained in an Interesting and Novel Fashion. By C. R. Gibson. Pp. 216. (London: Seeley and Co., Ltd., 1911.) Price 3*s*. 6*d*. net.

A BOOK with so strange a title may well excite our curiosity, for it is not unnatural to expect in such an autobiography interesting speculations as to the nature and functions of electrons going beyond the limits of certain knowledge, and putting forward ideas suggestive of possible future advances in scientific thought. But though the electron is made to give an account of its experiences in different natural phenomena and experiments, it discreetly declines to tell us anything beyond what we know to be facts or what we are accustomed to regard as accepted physical theories. What, then, is the object of this story of the electron—or, more correctly, this series of stories about the experience of the electron in the different experiments described in each chapter? To use the author's own phrase, it is to present to his readers "a book which they may read with the same ease as an interesting novel."

Now it must be admitted that this desire to present to the scentifically untrained reader the established facts and theories of modern science, in a simple and pleasant form, is much to be commended; for the lack of interest taken by the general public in such matters is certainly deplorable. The author is right in thinking that there are many who would take an intelligent interest in scientific progress, but do not care to go into details, and no doubt men of science are largely at fault for not providing such readers with suitable literature. But it is difficult to see what is gained by the somewhat childish device of making the electron speak for itself, and describing the phenomena in the first person rather than in the more usual third person; besides, the contents of each chapter is preceded by a short synopsis called the "scribe's note," and the subsequent text takes one very little further than this note.

Although the particular form of the book seems to have no special advantage, the facts dealt with and their explanations are set forth quite clearly, and with accuracy, so far as is possible, in an elementary way; but there are disadvantages in the method of presentation which are worthy of mention. Whereas when dealing with certain fundamental conceptions of electricity it may be useful to introduce the idea of electrons, to do so seems to add nothing to the understanding of our methods of employing electricity for telegraphy, lighting, traction, and so forth. The principles involved in such technical application can be described without any reference to the ultimate nature of electric currents, without any sacrifice of precision; in fact, the consideration of the motion of the electrons only serves to detract attention from the more essential points. Again, the method of making the electron tell its own story leads the author into rather dogmatic statements on doubtful points. Thus it is found necessary to take up a definite attitude with regard to the nature of X-rays, which are described as æther-pulses, whereas of late considerable doubt has been thrown upon the validity of this conception of the radiation. Taken as a whole, however, this little book is quite a good and interesting popular account of some of the more important ideas of modern physics.

OUR BOOK SHELF.

Cat's Cradles from many Lands. By Kathleen Haddon. Pp. xvi+95. (London: Longmans, Green and Co., 1911.) Price 2*s*. 6*d*. net.

THE problem of the origin and diffusion of games is now generally recognised to be of some ethnographical importance, and Miss Haddon, in her careful account of the mysteries of cat's cradle, has done something to increase our knowledge. Like all pioneers in a new field of inquiry, she has to lament the scantiness of her material. Here and there persons interested in the subject have picked up various forms of the game among American Indians and Eskimo, the people of Central and South Africa, in the Caroline and Andaman Islands, in Oceania and Australia. But large regions, like India, from which only a couple of examples come, still remain practically unworked; and until the search for the game is more widely extended there will be no certain means of deciding whether it originated in one or many centres, and by what routes and agency it was diffused.

It is not surprising, as Miss Haddon remarks, that some of the plainer forms should have a wider dis-

tribution, because, given a simple loop of string, they would soon present themselves to the mind of the ingenious savage. But it is much more difficult to account for the presence of one of the most complicated forms in the Andaman Islands, Torres Straits, Australia, and Central Africa. In some cases doubtless this is the result of direct transmission, as when the puzzled folk-lorist finds "Cinderella" in the Cannibal Islands, he may reasonably suspect that she came with the Berlin-wool work and the hideous forms of dress popular in mission schools. But until more materials become available it is useless to speculate in this way.

This is some evidence, again, that certain forms of the game may be derived from magic of the sympathetic or mimetic kind; and inquirers interested in the subject would do well to ascertain if it is ever accompanied by magic formulæ or songs.

Meanwhile, Miss Haddon has given us a useful little book which may lead to the popularisation of the game in the kindergarten as a means of training eye and finger, or as a pleasant mode of wasting time for those who are no longer children.

A Course of Practical Physics. By Prof. E. P. Harrison. Pp. x+194. (London: Longmans, Green and Co., 1910.) Price 4*s.* 6*d.* net.

This book is based on the syllabus of practical physics for the B.Sc. degree of the University of Calcutta, and contains upwards of seventy experiments of an advanced nature. The author states in his preface that laboratory manuscripts have been used in its compilation, and this is far too evident in the result produced. Such instruction forms very often suffer from vagueness and looseness of expression, and although this may not be of much importance in the laboratory, where further explanations can be given by a demonstrator, yet in a published text-book care should be taken to eliminate such blemishes and make the descriptions more general and concise. To cite an example:—The determination of the thermal conductivity of copper on p. 130; the method is that of Searle; one is told to set up the apparatus as in the figure. The copper bar is not lagged, nor is there any mention in the text of the necessity of such lagging. Again, on p. 21—the determination of the period of vibration of a pendulum—it is not clear that the period needs correction (1) for size of amplitude, (2) for damping, but the corrections are merged into one causing ambiguity.

The author describes the measurement of galvanometer resistance on p. 156 (Thomson's method), and begins by telling us that one of 100 ohms resistance is convenient.

In some places the statements are inaccurate, *e.g.* on p. 175, the "neutral temperature" of a thermo-electric couple is defined as that temperature of the hot junction for which the electromotive force vanishes when the cold junction is maintained at 0° C. On p. 144, we have "Plot a B-H curve as in Fig. 101 (hysteresis loop shown). Determine the hysteresis in ergs per c.c. per cycle by measuring the area of the curve."

There is no doubt much in the book that will prove useful to students preparing for a pass degree examination, but its value would have been enhanced by the bestowal of more care in editing.

How to Colour Photographs and Lantern Slides by Aniline Dyes, Water and Oil Colours, Crystoleum, and other Processes. By R. Penlake. Pp. 77. (London: G. Routledge and Sons, Ltd.; Dawbarn and Ward, Ltd.; n.d.) Price 1*s.* net.

Although in the greater number of cases the less handwork there is on a photograph the better, it is often possible to apply colour to photographs and lantern slides in such a manner as not to interfere in any way with their value as impersonal records, and at the same time to increase considerably their value for demonstration purposes, and, in certain circumstances, to enhance their beauty. Experience has shown that the most suitable results are obtained by special methods, without the knowledge of which even the most skilful worker suffers a great disadvantage. It is the technicalities of these special methods that the author describes, dealing first with transparencies and colouring or tinting photographs on the face of them, and in the second part with the art of applying colours on their backs. He gives full instructions as to tools, colours, and processes without wasting any space in "artistic" platitudes.

Fables and Fairy Tales for Little Folk; or, Uncle Remus in Hausaland. By Mary and Newman Tremearne. First series. Pp. iv+135. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

This is a popularised version of a series of folk-tales collected by Captain A. J. N. Tremearne, and published, with much useful information on the ethnology and customs of the Hausas, in the Proceedings of various societies. The tales add little to our knowledge of the manners of the people. Nearly all of them are based upon the theme of the transformation of men into animals and *vice-versa,* and there is little of the fairy element. The hero of many of the tales is Spider, who, like the fox of European and Chinese folk-lore and the jackal in India, is the type of the successful rogue. He is appointed king of the beasts, and in various ways swindles the elephant, rhinoceros, and hyæna. He marries a Hausa girl and has children, whom he shelters and dresses with his webs. His rival is the billy-goat, who plays tricks on the lion. In its present form, without notes or references from other folklore sources, the book is of little scientific value; but its quaint and humorous incidents of animal life will doubtless be fully appreciated in the nursery.

Early Britain. Roman Britain. By Edward Conybeare. Second edition, revised. Pp. 275. (London: Society for Promoting Christian Knowledge, 1911.) Price 3*s.* 6*d.*

This history of Britain, which extends to the year 455 A.D., begins with a treatment of the period shading on one hand into geology, and on the other into written history. The reader gets a glimpse of what the geologist has pieced together about the life of the inhabitants of this country in Palæolithic and Neolithic times, and an interesting account of the less ancient Britons. A very readable description is given of Britains under the Romans, in which the broad facts stand out clearly.

The Green Book of London Society. Edited by Douglas Sladen and W. Wigmore. Pp. xxii+524. (London: J. Whitaker and Sons, Ltd., 1911.)

This is the second issue of a comprehensive work of reference, the scope of which may be gathered from its sub-title:—"A Directory of the Court, of Society, and of the Political and Official World; including Celebrities in Art, Literature, Science, and Sport, with many other subjects of current interest." Science appears to be given about a page and a half, and the information includes a list of "eminent men of science who appear in London," the names of seven leading engineers, a list of twenty-four important scientific periodicals, and brief particulars of twenty-three scientific societies.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Flow of Thin Liquid Films.

WHILST observing the "Brownian" movement of particles of gamboge in water with the aid of a microscope (magnification, about 360 diams.), it occurred to me to press gently on the cover-glass of the slide, so as to cause a movement of the water containing the suspended matter, and to note the paths of these in the vicinity of some larger stationary masses, as one would then be approaching the condition set forth by the late Sir G. G. Stokes, namely, that liquids in thin films behave as frictionless fluids. The results fully confirmed the behaviour of such thin films of liquid. The moving particles, as they rushed by the stationary masses, showed no trace of eddy currents, passing along the edges of the obstacle and leaving it without any swirls, as shown in Fig. 1. The moving particles next to the obstacle had a high velocity, and were in greater numbers per unit area, than those further removed; the obstacle had no effect upon distantly removed portions of the liquid—they moved in straight lines. For very low velocities the course of the particles was exceedingly in accordance with the motion of a frictionless fluid. With high velocities, a cone of slow-moving liquid formed both in front and behind the obstacle, as shown in Fig. 2. When two masses are in the same line of flow, it is difficult to prevent a certain number of particles, mapping out a stream-line, from crossing over from one side to the other between the obstacles, as shown in Fig. 3. We have here a hydrodynamical analogy to the circuit of a Wheatstone bridge

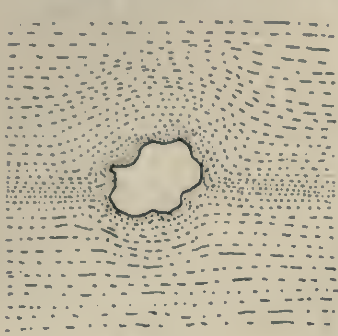


FIG. 1.

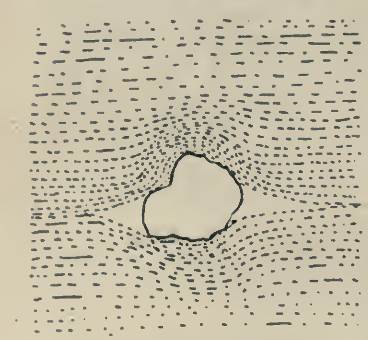


FIG. 2.

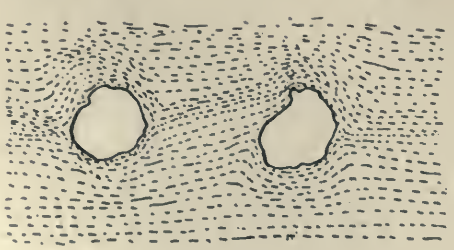


FIG. 3.

when determining the value of an unknown resistance. The liquid represents the metallic circuit, the particles of gamboge the current—or the corpuscles if preferred, the two obstacles the insulation between R_1, R_2 and R_3, R_4, and the fluid between them the galvanometer circuit. When equilibrium is established, no current flows through the galvanometer: no fluid passes across the intervening space between the two obstacles. Vary any one of the resistances, and equilibrium is upset, causing a current to flow through the galvanometer; cause an unbalanced pressure on one side or the other of the line joining the two obstacles, and a current of fluid flows from the place of greater to that of lesser pressure.

Very interesting effects are produced by introducing air bubbles into the liquid instead of solid obstacles. On pressing the cover-glass, the bubble appears to increase in size, while at the same time a rush of liquid passing it is noticed; on releasing the pressure, the bubble contracts, the liquid moving in the opposite direction. One of the most striking effects is seen when a bubble moves of its own accord through the liquid. The effect is difficult to produce, but well repays the effort. As before, gamboge is used to define the course of the surrounding fluid. As the bubble moves forward, the fluid next it is seen to be moving along its edge in the *same direction*, while at a little distance it is moving in the opposite direction to that in which the sphere moves. This effect is shown by the arrows in Fig. 4, the heavy arrow denoting the direction in which the sphere is moving: At the pole *c* the fluid seems to appear, passes with a high velocity to the pole *d via* the surface of the bubble, and disappears. The effect of the moving bubble on the surrounding liquid extends for a great distance compared with the case when the liquid is in motion and the obstacle stationary (*vide* ante).

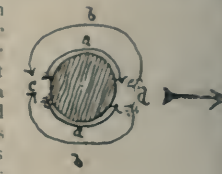


FIG. 4.

W. G. ROYAL-DAWSON.

4 Montague Street, London, W.C., March 6.

Water-Vapour on Mars.

I NOTE in NATURE of February 9 (p. 486) an account of a recent unsuccessful attempt to verify the existence of water-vapour on Mars, already demonstrated by means of other methods by Dr. Slipher and myself (see *The Astrophysical Journal*, vol. xxviii., p. 397, December, 1908, and Lowell Observatory Bulletins, Nos. 36, 43, and 49). Will you allow me to point out that the method employed by Director Campbell was proposed several years ago by Dr. Percival Lowell, and was actually tested by Dr. Slipher at the Lowell Observatory in 1905, with a result similar to that which Director Campbell has now obtained in his repetition of the experiment? The details may be found in Lowell Observatory Bulletin No. 17.

The reason for the failure perhaps lies in the insensitiveness of the method. The spectrum of a body no brighter than Mars cannot be obtained with the utmost fineness of detail under a high dispersion, because a relatively wide slit has to be used, or else a very long exposure must be given to the photographic plate, either of which is fatal to sharp definition of fine spectral lines. In these circumstances it is not easy to distinguish between the terrestrial and planetary components of a fine absorption line with the high dispersion which is absolutely necessary to the success of the experiment.

It still seems to me that the best method of measuring the Martian aqueous vapour which is at present available consists in the observation of the little *a* band with a spectrograph of low dispersion, which gives the band as a shading in which individual lines cannot be discriminated, but the integrated intensity of which can be measured photometrically. The method is also applicable to those diffuse bands discovered by Abney and Festing in nearly saturated aqueous vapour, which apparently are not composed of fine lines, but which are sometimes much more intense than the linear groups.

FRANK W. VERY.

Astrophysical Observatory, Westwood, Massachusetts, March 6.

The Fox and the Fleas.

I HAVE just been told a very interesting story by Mr. James Day of this town. Many years ago he and his father, both then engaged in agriculture, were sitting with their backs to the straw-covered hurdles which had

been put up to protect some sheep and lambs from the wind, when they noticed a fox come searching along the hedgerows. They kept perfectly still and watched, and, when he got nearer, they saw that he was collecting the sheep's wool caught on the thorns and brambles. When he had gathered a large bunch he went down to a pool at the junction of two streams, and, turning round, backed slowly brush first into the water, until he was all submerged except his nose and the bunch of wool, which he held in his mouth. He remained thus for a short time, and then let go of the wool, which floated away; then he came out, shook himself, and ran off.

Much astonished at this strange proceeding, they took a shepherd's crook, went down to the water's edge, and pulled the wool out. They found that it was full of fleas, which, to save themselves from drowning, had crept up and up the fox's brush and body and head and into the wool, and that thus the wily fox had got rid of them.

Cambridge, March 20. T. MCKENNY HUGHES.

THE CIRCULATION OF AIR IN THE SOUTHERN HEMISPHERE.[1]

IN this investigation of the circulation of the atmosphere in the southern hemisphere, the author has taken a new course. Instead of proceeding in the usual way from tables of wind-direction and force, he has taken as the groundwork of his researches the atmospheric whirls themselves. He does not deal with cyclonic systems, as one might at first suppose, but with the anticyclonic, the travelling high-pressure systems. The reason of this is plainly due to his previous work, "A Discussion of Australian Meteorology" (London, 1909). After a four-year period in the variations of air-pressure over India, South Africa, and South America, and their relations to the four-year cycle in the solar variations had been successfully demonstrated, it was necessary to investigate the weather conditions in Australia with that object. In the subtropical continents of the southern hemisphere weather conditions are chiefly influenced by barometric maxima almost constantly travelling from west to east. This was first shown to be so for Australia by the astronomer H. C. Russell, of Sydney, to whom the meteorology of that continent is so much indebted.

Russell already held the opinion that these travelling barometric maxima (with the V-shaped depressions accompanying them on their south side) do not originate on the continent itself, but approach from the South Indian Ocean. In Dr. Lockyer's extensive work, above quoted, it was shown more conclusively that in the Australian area, in latitudes 20° to 40° S., anticyclonic systems travel with great velocity from west to east, and that this also holds good for South America, South Africa, and Mauritius, in the same belt of latitude. In all probability, what holds good for 130° of longitude would also obtain for the rest of the earth's circumference. A proof of this would be of great importance for the weather prediction of these southern continents. The inquiry was therefore extended over the whole southern hemisphere, in order to obtain at the same time a more secure basis for the determination of the effects of the solar variations on the circulation of the air of the southern hemisphere.

The collection of the materials for this widely extended investigation naturally gave the author much trouble and difficulty. The determination of the amplitudes of the waves of atmospheric pressure over the whole of the district in question formed the preliminary part of the work in view. The author rightly confined himself to the southern winter half-year (April to September). It is quite clear that in calculating the mean height of the pressure waves, all waves, including even the smallest, cannot be taken into account, but only those of a certain magnitude. The author finds the amplitude of the pressure wave (Schwellenwerth) for these by selecting the three greatest wave heights for each station and takes one-fifth of the mean as the lower limit. This value (Schwellenwerth) is naturally different for different places in the various latitudes.

Dr. Lockyer calculates in this way the mean heights of the waves of air-pressure for fifty-five places in the southern hemisphere, between the equator and the Antarctic continent, and enters the values in the chart. That leads further to the drawing of lines of equal wave heights of oscillations of air-pressure. The author denotes these lines by the somewhat mysteriously sounding Greek compound "Isanakatabars": lines of equal up and down movements of air-pressure. The mean amplitudes of the waves of air-pressure naturally increase from the tropics towards higher latitudes. In latitude 0° to 12° S. they reach 1 to 2 mm.; from 12° S. they increase very rapidly and attain a maximum of 18 to 19 mm. in 53° to 60° S., and then decrease again to 14 to 15 mm. in South Victoria Land. The Isanakatabar of 16 mm. occasionally fringes the Antarctic continent. The increase of the wave heights towards the south is explained by the fact that from the belt of the travelling barometric maxima, with still relatively small amplitudes, we first enter the region of V-shaped depressions which accompany them, and then, finally, that of the large cyclones of higher latitudes, the mean tracks of which may probably be taken as between 55° and 60° S. At the southern limit of these, towards the permanent Antarctic anticyclone, the amplitudes again decrease. But, generally speaking, the Isanakatabars run fairly parallel to the parallels of latitude. They exhibit, however, the peculiarity that on the mountain ranges of the west sides of South Africa and South America they trend downwards in higher latitudes, but leave the east coasts in lower latitudes. This may be ascribed to the westerly ranges of mountains in these continents.

These Isanakatabars form the starting point of further very interesting deductions by the author.

It may here be remarked that Kämtz, in his "Lehrbuch der Meteorologie" (vol. ii., p. 339), has endeavoured to draw lines of equal non-periodical oscillations of air-pressure. He calculated for numerous stations of the northern hemisphere the mean value of the *monthly variation* of air-pressure, and called his lines based thereon somewhat improperly "isobarometric" lines. It is certainly noteworthy that lines of equal barometric variation were drawn (1832) long before it was thought of constructing lines of equal air-pressure (isobars). These were first drawn by Renou (1864), and then particularly by Buchan (1869). Kämtz also remarked that his lines did not run wholly with the parallels of latitude, but that, *e.g.* the line of 8 par. lines = 18 mm., is met with on the east coast of the United States in 36° N. latitude, but in western Europe in 42°. At a much later period Fehlberg and Köppen again investigated the variations of air-pressure on a much broader basis, but also for the interval of a month (*Aus dem Archiv d. Deutschen Seewarte*, 1878, and *Meteorologische Zeitschrift*, 1883). These *monthly* barometer variations are naturally a much rougher measure of the irregular variations of pressure than the mean height of the individual pressure waves calculated by Dr. Lockyer. Köppen has already remarked that the lines of equal variations of air-pressure should be in relation with the direction of the tracks of the barometer minima.

[1] Solar Physics Committee. Southern Hemisphere Surface-air Circulation: Being a Study of the Mean Monthly Pressure Amplitudes, the Tracks of the Anticyclones and Cyclones, and the Meteorological Records of several Antarctic Expeditions. By Dr. W. J. S. Lockyer, under the direction of Sir Norman Lockyer, K.C.B., F.R.S. Pp. ix+111+xv plates. (London: H.M.S.O., Wyman and Sons, Ltd. Edinburgh: Oliver and Boyd. Dublin: E. Ponsonby, Ltd., 1910.) Price 6s.

Lockyer shows that, *e.g.* the Isanakatabar of 10 mm. in Australia coincides with the average track of the barometer maxima in that continent.

The next question was: with what velocity do these pressure waves progress from west to east.

By superposing the air-pressure curves of stations of different longitudes (first in Australia) and by shifting the time scale until the crests and troughs of the waves coincide, the difference of time of their occurrence at different places is indicated at once. In this way Lockyer obtains for the continent of Australia a daily velocity of progression of the barometric maxima from west to east of 11·5° of longitude, for South Africa, 12°, for South America, 11·1°, giving a mean of about 11·5°. The velocity over the oceans is naturally much more difficult to determine; Port Durban—Perth, gives for the South Indian Ocean about 9·5° a day; Adelaide—Rikitea, for the Pacific, 9·3°. Still more uncertain is the determination for the South Atlantic, which gives about 9·2°. Over the oceans therefore the barometric waves progress with less velocity. Lockyer gives 9·2° a day as the mean value (the Antarctic Ocean comes out as 9° to 10°). So we may adopt a general mean of 10·7°, whence it would follow that anticyclones travel round the earth in about 33·6 days. The author in no wise assumes therefrom that the anticyclones remain constant in form and intensity during their progression; on the contrary, they are subject to continual changes. He estimates their length of life on the oceans to be about six to seven days.

The wind and temperature observations, also, of all Antarctic expeditions, including the most recent one by Shackleton, are discussed in detail with reference to the problems of atmospheric circulation at present in question; series of barometric minima progressing from west to east are also shown. In longitude 30° to 90° W. the paths of the barometric minima appear from these observations (*Belgica* and *Scotia*) to lie more to the south than in the easterly longitudes. This seems to show that the centre of the Antarctic anticyclone is not at the pole itself, but in easterly longitudes, far therefrom, at the farthest, perhaps, in 130° E.

A coloured frontispiece, a chart of the southern hemisphere on the polar projection, gives a good schematic representation of the barometric minima and maxima that encircle the pole, and of the warm and cold air-currents proceeding from them. In the rear of the minima the permanent Antarctic anticyclone sends cold currents to lower latitudes, while, in front of them, warm air spreads to the Antarctic regions. These formations of the warm and cold currents gear into each other like toothed wheels, while they are constantly rotating round the pole.

With reference to the apparently permanent barometric maxima over the subtropical oceans, which lie nearer to the west than to the east coast of the continents in all oceans, Lockyer develops entirely new ideas which are very interesting and worthy of further examination.

The subtropical barometric maxima lie in the belt of anticyclones constantly travelling from west to east between lat. 20° to 40°. They are not fixed forms, and form no barriers to atmospheric circulation, but indicate only the spaces where the anticyclones which are actually travelling are mostly reinforced. Over warm land-surfaces anticyclones are weakened and partially effaced; over the cool sea-surfaces they are strengthened.[1] *They therefore arrive on the west coasts of the continents with greater intensity tha that with which they left the east coasts of the same*

[1] Perhaps I may here correct a slight error which has been taken from Buchan's "Meteorology." The specific heat of water is to that of firm land not as 4 to 1, but only 2 to 1. The question here is the "volume capacity," the specific heat for equal volumes. For dry ground this is 0·5 (for damp, about 0·6), compared to water. The ratio of specific heat for equal weights is only as 0·2 to 1·0.

This very interesting view could only originate i the study of the circulation of the air over th southern hemisphere, for in the northern, the condi tions are usually too complicated and disturbed b the land-surfaces.

The author deals only with the air-currents at th earth's surface. Nor does he go into the question o the nature and origin of anticyclones and cyclones He rightly confines himself to establishing facts which must certainly precede theories.

Dr. Lockyer's investigation, the contents of whic I have briefly sketched, is a very valuable contribu tion to our knowledge of atmospheric circulation Objections will probably be raised to many points but it is pure gain to the science if occasion is give for further discussion. For the simple reason tha the author does not follow the ordinary beaten track but presents entirely new views for examination, hi work will have a very stimulating and useful effect.

J. HANN.

THE INSTITUTE OF HUMAN PALÆONTOLOGY.

ATTENTION was recently directed in NATUR (January 26, p. 412) to the establishment by th Prince of Monaco of an institute of human palæonto logy in Paris. The council of administration has no been appointed; it consists of his Highness the Princ as president; MM. Dislère and E. Mayer, conseiller d'état; MM. Boule and Verneau, professors o palæontology and anthropology in the Muséum d'hi toire naturelle in Paris; M. Salomon Reinach, membe of the Institut and Conservateur of the Musée de antiquités nationales; and M. Louis Mayer, conseill intime of the Prince. On account of his great se vices to archæology and his administrative experienc Prof. M. Boule will be the director of the institut Two collaborators have been appointed: l'Abbé I Breuil, professor of prehistory and ethnography of th University of Fribourg, who will occupy the chair o prehistoric ethnography, and Dr. H. Obermaie privat-docent in prehistory at the University o Vienna, who will be professor of geology in its rel tion to prehistory.

We have frequently directed attention to th numerous and excellent researches of Prof. H. Breu upon the pictorial and glyptic art of Palæolithic ma Dr. H. Obermaier has been associated with Hoern and Penck in Germany, and Boule, Cartailhac, Breui and Capitan in France; he has made a special stu of glacial problems, and has investigated th Pyrenean region from this point of view. He h also published important papers on the form an stratigraphy of the older stone implements.

The professors will direct the explorations and e cavations undertaken by the institute, personally o with the aid of other specialists. The results will b published as monographs, in addition to short articles. During the dead-season they will give assis ance and instruction to students who desire to make serious study of fossil man. Lectures on the wor of the institute will be given to the general publ from time to time.

The institute will eventually possess an adequa library, specimens, and instruments; and not on will it bring to a focus all existing information on th subject of human palæontology, but it will be th main centre of all future researches. The stimulati and direction which the institute will afford will soo make itself felt, and in the near future we may loo forward to a considerable increase in our knowledg of the early history of mankind.

THE ETHNOLOGY OF YORUBA AND BENIN.[1]

ANYTHING which Mr. Dennett writes in connection with the Black man is bound to be of interest and importance to ethnologists; for even if they disagree with his ultimate theories and deductions they are ready to acknowledge the truth, and often the novelty, of the facts and observations he places on record. In many respects the book under review, which deals mainly with the Yoruba people of the western part of southern Nigeria, is superior to any he has as yet written, in that it contains more undoubted facts and accurate observations than deductions which set one's teeth on edge (as in "At the Back of the Black Man's Mind"), because they are based on insufficient evidence or lack of comparative study of other African races or languages. In fact, it may be said at once without too many qualifications that this work of Mr. Dennett on the Yoruba people is a remarkable book of permanent value to the ethnologist and to the student of Africa. It is, indeed, a special insight into the religious ideas of this highly developed negro people, from whom undoubtedly sprang the closely related art and civilisation of Benin, and most of the religious ideas to be found throughout southern Nigeria from Dahome to the Cameroons.

Yorubaland seems to have been invaded at a relatively early date by northern influence coming from Bornu, Hausaland, and the Fula and Songhai countries of the Upper Niger. We know from the interesting researches of Clapperton and Lander that in the early part of the nineteenth century the country of Borgu, which borders Yorubaland on the north, possessed amongst other evidences of northern influence a corrupted version of Christianity of some ancientness, said traditionally to have been brought there by Tuaregs or Berbers from the Sahara Desert. Similar traditions (accompanied by good collateral evidence) derived from Bornu or northern Hausaland most of the old dynasties of Borgu and other countries bordering the Lower Niger. It is, therefore, no difficulty to go a step farther and believe with Prof. von Luschan and other authorities that European influence penetrated far south into the Niger basin and the Cameroons before the times of Islam and the Roman Empire. Von Luschan can indicate in the Ethnographical Museum of Berlin very marked parallels between the art and the religious emblems of the Benue, Lower Niger, and Camerons regions, and those of Crete and ancient Greece. This analogy, again, quite independently, is pointed out by Mr. Talbot in the December number (1910) of the *Geographical Journal* ("The Land of the Ekoi"). Similarly, in reading Mr. Dennett's extraordinarily interesting description of Yoruba religious ceremonials and traditions, one is reminded of those of the Mediterranean peoples two thousand years ago and more. On p. 163 Mr. Dennett gives in Latin the exact text of the erotic songs declaimed by the women at a religious festival, which must have been very similar to the mysteries of Cybele and other similar phallic- and nature-worship manifestations of religion among the Greek and Latin peoples.

All that Mr. Dennett writes on the subject of marriage and totems (beginning on p. 176) is of great interest, and so far as the reviewer's knowledge goes, quite accurate. In connection with this, allusions are made from time to time in the book to the question of polygamy *versus* monogamy, and Dr. E. W. Blyden is quoted in defence of polygamy as being the system best suited to the negro race. With these opinions the reviewer differs. In his own books—especially that which dealt with the researches of George Grenfell on the Congo—he has given evidence to show that there is a greater proportional increase

Tree planted over Grave which thus becomes sacred. From "Nigerian Studies."

amongst negroes who practise monogamy—namely, cohabit with only one spouse, at any rate ostensibly—than amongst those who avowedly practise polygamy. The very conditions under which polygamy is practised in Africa limit to very few the number of children which each woman produces, nor does it follow necessarily that these few children are any healthier or better brought up than those which are the outcome of a monogamous union. In any case, this is almost indisputable: that the civilised negroes of the New World who profess to be monogamous—and are so, nearly as much as are the white people of the same region—are increasing at a faster rate than the polygamous peoples of Africa; are produc-

[1] "Nigerian Studies," or the Religious and Political System of the Yoruba. By R. E. Dennett. Pp. xv+235. (London: Macmillan and Co., Ltd., 1910.) Price 8*s*. 6*d*. net.

ing children quite as vigorous in physique and much better endowed mentally than the average native of Africa.

An interesting allusion is made in this book to the origin of fire, interesting because the native tradition quoted by Mr. Dennett is in accord with the observations and theories of several African explorers. On p. 216 he quotes the Yoruba legend that before man knew how to make fire, bush fires used nevertheless to occur almost yearly at the end of the dry season "when natural combustion took place." In Africa, at any rate, this was how fire became an agent of man. I have seen myself lightning set fire to a dead tree or to the dry grass near a tree, and thus start a bush fire in the dry season. Bush fires are very detrimental, in reality, to civilised agriculture in Africa. Nevertheless, in regions where the natives appreciate this fact and do not set fire to the grass or brushwood, bush fires occur from time to time in the dry season, and the natives assert that they are due to some natural cause, more especially to lightning, but also, it has been suggested, to some action of the sun, possibly of "a burning-glass" character acting through silica or some other mineral substance which concentrated the rays on to tinder. But lightning frequently starts a fire in Africa—as witness the cathedrals, barracks, hospitals, &c., which are burnt to the ground from this cause. The spread of the bush fire proved to be of enormous benefit to early man, since when he followed behind its ravages he was presented by nature with a variety of cooked or half-cooked beasts, birds, and reptiles. In this way he learnt the charms of cooked food and the usefulness of fire, and no doubt began to count on the annual opportunities offered to him in the dry season for the renewal of his household fire before he learnt to produce a flame artificially.

The chapter dealing with totems (p. 175 *et seq.*) is particularly interesting, and useful information is given on the laws and customs of land tenure.

H. H. JOHNSTON.

HIGH-FREQUENCY GENERATOR FOR WIRELESS TELEGRAPHY.

IT is announced in the daily Press that Dr. Goldschmidt has recently succeeded in sending wireless messages from Berlin to the South-Western frontier of Germany using his new high-frequency alternator to generate the electric oscillations. The production of undamped waves by means of high-frequency alternators has been the aim of numbers of inventors, as it is hoped that by producing a suitable generator it may be possible to avoid the defects of working that are associated with the usual arc and spark methods.

A number of alternators have been built, but owing to various reasons none of them have as yet come into extended use. Their design on the usual lines is very difficult, as even if the rotating parts are made to revolve at the highest speeds permissible from mechanical considerations, the number of poles required to produce the high frequencies necessary for wireless telegraphy is so great as to leave very little room for the windings, and the consequent cramping of the windings and great leakage between the closely spaced poles give rise to considerable drop of voltage when load is put on the machine.

Most of the machines that have been constructed hitherto have been of the inductor type, consisting of fixed windings placed under the influence of rapidly rotating armatures of iron containing a large number of projections or teeth, but the Goldschmidt machine is built on a quite different principle.

It is a phenomenon well known to those who have to work with single-phase alternators that when load is put on such machines the armature reaction causes double-frequency currents to flow in the field winding, and that these double-frequency currents cause triple-frequency currents to flow in the armature winding, and so on. This may be explained by the consideration that a stationary alternating flux can be regarded as being composed of two equal and constant fluxes rotating with equal speeds in opposite directions, the speed of the two fluxes being such that one complete revolution is made by them in the time of one period of the alternating flux.

Applying this to the case of an alternator with stationary alternating-current winding and rotating field system, it will be seen that if the rotating field produces alternating currents of a frequency f in the stator, the component rotating fields produced by the stator currents will rotate at the same speed as the field system, one in the same direction as the field winding, and therefore having no inductive effect on it, and the other in the opposite direction, and therefore inducing a current of a frequency $2f$ in it. A continuation of this process would cause currents of frequencies $2f$, $4f$, $6f$, &c., to appear in the field winding, and currents of frequencies $3f$, $5f$, $7f$, &c., to appear in the stator winding. The production of the higher frequency currents in ordinary alternators is limited by the fact that the amplitudes of the series of harmonics decrease rapidly owing to the great impedance opposed to their flow in the windings, but the triple-frequency harmonic superposed on the fundamental is often sufficiently marked to cause undesirable distortion of the wave-shape of the electromotive force of the machine.

Dr. Goldschmidt has constructed a machine in which the effect referred to is utilised to produce currents of very high frequencies, although the fundamental frequency of the machine is comparatively low. In order to prevent the damping out of the higher harmonics, he connects in parallel with the stator windings a series of capacity-inductance shunts tuned to resonance with the odd multiples of the fundamental frequency of the machine, and in parallel with the field winding a series of such shunts tuned to resonance with the even multiples of the fundamental frequency. Owing to the presence of these shunts the high-frequency currents are able to attain considerable magnitudes, and the electrical energy is reflected backwards and forwards between the stator and rotor of the machine a great number of times, the frequency of the oscillations being increased at each reflection until a frequency corresponding to the free period of the radiating circuit is reached.

In Dr. Goldschmidt's machine, oscillations of 120,000 cycles a second are produced, and the rated output is 12 kilowatts.

Practical experience of working will be necessary before it is possible to say to what extent machines of this type are likely to replace the present oscillation generators, but it seems not unlikely that difficulties will arise in keeping the frequency of the oscillations constant enough to enable clear signals to be received. It would appear that any small variation of the speed of the generator would cause each successive harmonic to depart to an increasing extent from its proper frequency, so that the final frequency reached might be so far removed from its proper value that signals would no longer be able to be received; added to this the amplitudes of the harmonics might be expected to be greatly diminished by the fact that a change of the speed of the machine would put all the capacity-inductance shunts out of tune with the harmonics for which they are adjusted, and a considerable weakening of the signals emitted by the aërial would result.

A. J. MAKOWER.

RECONSTRUCTION OF THE UNIVERSITY OF LONDON.[1]

THE period covered by Part ii. of Sir William Allchin's account of the reconstruction of the University of London[1] is comparatively short—three years, but it was an important period, that included attempts and failures that should afford valuable information to the Commission now sitting for the purpose of offering advice towards the further progress of reconstruction. The portion of Sir William Allchin's account now before us occupies, with the appendices, upwards of 500 pages; it presents the advantages, as well, perhaps, as the disadvantages, of a compendious Blue-book, containing numerous quotations from original documents, together with a detailed account from the point of view of a highly qualified witness of events in the order in which they developed, while, as indicated by the author himself, the account is substantially a compilation of actual documents; and although the period dealt with is very short, the compendious character of some of these documents is such that Part ii. by itself contains a reasonably intelligible, as well as a very authoritative, account of the process of reconstruction up to the date of the Selborne Commission of 1888. Although in some respects the difficulties of reconstruction have altered since 1891, the nature of the problem to be solved by the Commissioners remains the same, while the conditions to be fulfilled have become more apparent.

It is as clear to-day as it was twenty years ago that a real university is required in London; a university in which examination is not divorced from teaching, in which the teacher who has been the examiner of his pupils during their whole curriculum shall, with the cooperation and consent of an independent authority, "brand his own herrings." It is equally clear from the extension and development imposed by the force of circumstances upon the University of London—the examining body—when it was separated from University College—the teaching body—that upon the university of the metropolis devolves the duty of holding up to the British Empire the standard of excellence. There must be a university belonging to the great province of London, as there is a University of Manchester and a University of Liverpool, and there must be a university in London belonging, not only to London, but also to York or Toronto or Melbourne, and there must be in London, not two universities, but one university. On its metropolitan side, by force of geographical circumstance, it must include many colleges variously situated but under one common government. On its Imperial side it must say, "*Come and be tested,*" not only to the student at the end of his first few years of pupilage, but to the perpetual student, to the professor who has succeeded in learning something from Nature at first hand.

It is as true now as it was in 1888 to say that "it would be a mistake to constitute a local teaching university in London as a mere branch of a great examining body," and it would be an advantage now, as in 1888, if the title "London" were held by the teaching university, whilst the existing University of London should be styled "Imperial" (p. 32); and while it is probable that the new University of London would feed the old university, it is hardly less probable that the Imperial University of London would play its natural part in the intellectual commerce of the Empire.

[1] "An Account of the Reconstruction of the University of London." Compiled by Sir W. H. Allchin. Part ii. From the Appointment of the First Royal Commission to the Rejection of the Scheme of the Senate by Convocation, 1888 to 1891. Pp. vii+449+c. (London: H.M.S.O., Wyman and Sons, Ltd.: Edinburgh: Oliver and Boyd; Dublin: E. Ponsonby, Ltd., n.d.) Price 5s.

No one is better qualified than Sir William Allchin to present us with a clear account of the complication of causes to which the gradually progressive depletion of the London medical schools was attributable, and to the share in that depletion for which the University of London was responsible by reason of its high standards (p. 89). But recent history, and especially the comparative failure of the movement for the concentration of preliminary and intermediate medical studies, do not fall within the period dealt with.

Much water has, indeed, flowed under the bridges since 1891, and the final failure of the two teaching colleges on the one hand, and of the two royal colleges on the other, to produce, either separately or conjointly, any generally acceptable scheme of university organisation, are now matters of ancient history. Reconstruction has taken place under the advice of the Cowper Commission of 1892–4, and of the Statutory Commission of 1898, and the university reconstructed by the Commissioners appointed under the University of London Act, 1898, is now eleven years old; but it may be doubted whether the present structure can be regarded as possessing its definite and permanent form. The doubt expressed by the academic moiety of the Selborne Commissioners as to the possibility "of effectually combining the functions of an examining body, and of a teaching as well as an examining body, in the University of London," appears to have been verified by the progress of events, and advantage has been taken of the new fact of the foundation of the Imperial College of Science and Technology to bring the whole question of university reorganisation in London under the scrutiny of yet another Royal Commission.

The report in 1906 of the Departmental Committee on the Royal College of Science, suggesting that a Royal Commission should be appointed to consider what changes should be made in the character and constitution of the university, which would make it desirable to amalgamate an imperial college with the university, succeeded in the following year by the foundation of the "Imperial College of Science and Technology," and a year later by the request that a Royal Commission should be appointed for this purpose—have led to the appointment of the Commission of 1908, with terms of reference which have set before it a task of far greater scope and complexity than was allotted to either of the two previous University Commissions. Lord Selborne's Commission was instructed

> to inquire whether any, and what, kind of new university or powers are required for the advancement of higher education in London.

The terms of reference to Mr. Haldane's Commission, now sitting, are as follows:—

> To inquire into the working of the present organisation of the University of London, and into other facilities for advanced education (general, professional, and technical), existing in London for persons of either sex above secondary-school age; to consider what provisions should exist in the metropolis for university teaching and research; to make recommendations as to the relations which should in consequence subsist between the University of London, its incorporated colleges, the Imperial College of Science and Technology, the other schools of the University, and the various public institutions and bodies concerned; and, further, to recommend as to any changes of constitution and organisation which appear desirable. In considering these matters, regard should also be had to the facilities for education and research which the metropolis should afford for specialist and advanced students in connection with the provision existing in other parts of the United Kingdom and of his Majesty's Dominions beyond the Seas.

The dual character of the problem set before the Commissioners is clear enough in these instructions, but the duality is no longer restricted to the academic field of teaching and examination. The conflicting views of the teacher and of the examiner are but a small part of that problem, the "dualities" of internal and external interests, or of incorporated and non-incorporated colleges, or of academic and technological ideals, are dominated by the still more cogent duality of Metropolitan and Imperial.

The accidental development of an Imperial University under the Metropolitan name can be remedied and utilised in one way alone. The University of London is *de facto* the rough sketch of an Imperial University that should be distinguished by the name "Imperial." The Incorporated Colleges are *de facto* the nucleus of a Metropolitan University that should be distinguished by the name "London."

THE FUR-SEALS OF BERING SEA.

WE learn from *The Times* of March 17 that Russia has accepted an invitation from the United States Government to take part in a new Seal Fishing Conference at Washington a few months hence, probably in the spring of 1912, and Sir Edward Grey has announced in the House of Commons that an official invitation addressed to this country is now upon its way. It is generally understood that this invitation will be accepted, and that the Home Government, together with Canada, will take part in a friendly discussion upon this once difficult and contentious subject.

It is now eighteen years ago since the Paris Tribune of Arbitration gave its ruling, the gist of which was that, while the United States had no rights of property in the seals outside the ordinary three-mile limit, yet that in the special circumstances of the case it was desirable that that legal limit should be set aside and a wider boundary fixed; and as a matter of fact a close time was appointed, and a zone of sixty miles around the Pribyloff Islands was preserved against the operations of the "pelagic sealer." Three years later the question was again raised by a celebrated letter addressed to our Ambassador by Mr. John Sherman; but after inspection of the seal-rookeries by British experts, and a re-discussion of the whole circumstances of the case at Washington, no sufficient reason was found for disturbing the decision of the Tribunal, and the case has since remained *in statu quo*.

During the thirteen or fourteen years that have elapsed since the Washington conference no inspection of the rookeries has taken place by British agents, and but little news concerning their condition has reached this country; but there can be no doubt at all that the herds have greatly deteriorated during these recent years. The American agents declare that the seals are now only one-fourth as many as at the time of the arbitration, when already the diminution had gone far. At the same time, the Canadian sealing fleet has dwindled almost to nothing, and accordingly the responsibility for the recent depletion of the herds must lie on other shoulders than our countrymen's.

It appears that it is now the Japanese who are mainly responsible. As Japan was no party to the Paris Arbitration, the sixty-mile limit has never applied to them, and the Japanese sealers accordingly ply this trade around both the Russian and American islands right up to the three-mile limit, and (if report says truly), even sometimes to the very shore. During the years of the Russo-Japanese war it is said that the Commander Islands were freely pillaged, and it is certain that nowadays the Japanese fleet—non-existent a dozen years ago—is both large and active. In 1908, it is said by the United States agents that the Japanese fleet consisted of no fewer than thirty schooners, some with as many as sixteen boats, and rumour has it that our own countrymen in British Columbia have attempted to put their vessels under the Japanese flag, so as to evade exclusion from the sixty-mile zone. It is believed that Japan has agreed to take part in the impending conference if Great Britain likewise agrees to participate, and there is thus every reason to hope that an arrangement may be come to by which the destruction shall be arrested, and the herds gradually restored.

PROF. JAKOB MAARTEN VAN BEMMELEN.

IN the death of Prof. van Bemmelen, which took place on March 13, there passes away the oldest member of that singularly distinguished band of chemists and physicists which has had its home at the University of Leyden.

Born on November 3rd, 1830, at Almelo, where his father was head of the Grammar School, Prof. van Bemmelen was in his eighty-first year at the time of his death. His father died in 1830, and the widow moved to Leyden, where her son attended the High School, until he entered the University in 1847. He studied chemistry under the then professor of chemistry and pharmacology, van der Boon Mesch. Van Bemmelen has himself left on record a description of the very primitive laboratory—a single room with wide old-fashioned hearth in the great St. Catherine Inn in Breedestraat, serving as lecture-room and laboratory. There, as he notes, chemical instruction could go no further than the simplest quantitative experiments!

In 1852 van Bemmelen became assistant to Prof. van Kerchoff at Groningen, and it is owing to the fact that the students were mostly interested in pharmacology that his earliest papers were purely pharmacological in character.

Van Bemmelen's life work, his investigation of the colloidal state, came to him when he left Kerchoff to become teacher in the School of Agriculture at Groningen. There he began his analysis of soils, and there also, in 1864, he began to experiment on the "absorption processes in mould," the results of which were not published until 1877, thirteen years later. This delay was due to pressure of other work, largely alien to the young chemist's tastes. In 1858 he had married the daughter of the Rev. Jan Boeke, Baptist minister at Amsterdam, a lady whom the writer remembers as a gracious and kindly hostess at Leyden ten years ago, and the necessity for providing for his home led him to accept with much misgiving the position of director of the High School at Groningen when it was offered in 1864. There he stayed for five years, with little time or opportunity for laboratory work, and, as he himself has recorded in the Gedenkboek of the school, much distressed at the slow progress he could make in his studies of absorption. In 1869 he was moved to the High School at Arnheim, where he remained until the final move to Leyden in 1873.

Though the chief work scarcely progressed at all during these years of school administration, they were not wholly barren of scientific work. More than twenty papers were published, all on problems of agricultural chemistry. To this period also belongs what van Bemmelen himself very characteristically called his greatest contribution to chemistry—the discovery of Bakhuis Roozeboom, who came to assist him in soil analysis.

In 1873, the chair of chemistry at Leyden becoming vacant owing to the retirement of van der Boon Mesch, Dr. van Bemmelen was elected into it, and Bakhuis Roozeboom became his assistant. The first ten years of the professorship were almost exclusively devoted to the chemistry of soils, and the results place van Bemmelen in the front rank of agricultural chemists. Thenceforward, from 1880 onwards, the rest of his long and active life was devoted to elucidation of absorption as a phenomenon of the colloidal state.

In this region van Bemmelen ranks as a pioneer, and his fame rests now, and must always rest, on his classical researches on the relations between the components in the hydrogels of various colloidal oxides.

The work is in the main experimental and descriptive. It embodies an enormous amount of exact observation which has not yet been fully assimilated into the general body of knowledge. In one marked respect van Bemmelen stands apart from the Dutch school of chemists. With the exception of an address on the application of thermodynamics to chemistry which he delivered when rector of the university of Leyden in 1889, van Bemmelen's work is non-mathematical. His colloidal work is the application of the old-fashioned descriptive and experimental methods to a new region. His first assistant, Roozeboom, and his second assistant, Schreinemakers, on the other hand, were purely of the thermodynamic school.

Van Bemmelen possessed great personal charm. No picture which the present writer has seen does justice to features which were singularly delicate and refined. As the descendant of an old Dutch family, he was somewhat of an aristocrat in altogether the best sense of the word. Although his devotion to science was intuitive and instinctive, it left space for many interests amid the "humanities." As his life-long friend and colleague in the professoriate, Prof. Tiele said of him:—"Although an assiduous investigator in special fields of learning, van Bemmelen always bore in mind those greater questions the answering of which is the aim of us all."

W. B. H.

DR. JOHN ATTFIELD, F.R.S.

ON Saturday, March 18, Dr. John Attfield passed to his rest, and scientific pharmacy lost one who had devoted much of his life and work to its advancement.

Born in 1835, Attfield, after the completion of his school education, became a student in the School of Pharmacy of the Pharmaceutical Society, and subsequently demonstrator of chemistry at St. Bartholomew's Hospital, a position which he occupied for eight years. In 1862 he graduated at the University of Tübingen. In the same year he was appointed director of the laboratory of the Pharmaceutical Society, and soon afterwards professor of practical chemistry, a chair which he filled for thirty-four years. During this long period Attfield devoted himself, with marked success, to the advancement of pharmacy and particularly of chemistry as applied to pharmacy. His industry and ability in this respect is attested by the long series, some seventy in number, of original articles that appeared under his name in the *Pharmaceutical Journal* and other journals, an industry and ability that was soon to be rewarded by the blue ribbon of science, the Fellowship of the Royal Society. Of his publications the most important, and that which undoubtedly had the most far-reaching influence, was his "Handbook of Practical Chemistry," a work which was quickly accepted, both in this country and abroad, as an ideal text-book for students of pharmacy.

But it was not by his scientific labours alone that Attfield accomplished so much for pharmacy. Himself an admirable organiser and possessing extraordinarily methodical habits, he took an active part in founding the British Pharmaceutical Conference, an association that has proved itself of inestimable value to pharmacy, and later the Institute of Chemistry. To the subject of pharmaceutical education he devoted much time and attention, and no more strenuous advocate could be found of the advantages that would accrue to pharmacy through the raising of the standard of education amongst its members. Further scope for Attfield's scientific ability and inclination presented itself in the editorship of the "British Pharmacopœia" and of two of its addenda. The pages of these works bear abundant testimony to the care and skill that was bestowed upon them.

To his students Attfield was a genial, kindly teacher, ready at all times to sympathise with them, to assist them in their difficulties, to encourage them by becoming a student himself, and to stimulate them by holding up to them an ideal towards which they should strive. Much as he accomplished directly, it was little compared with what he accomplished indirectly by organising others and directing their efforts. During the thirty-four years of his teaching career many hundreds of students passed through his hands; there is not one that does not owe a debt of gratitude to John Attfield.

HENRY G. GREENISH.

NOTES.

THE annual meeting of the British Science Guild will be held at the Mansion House on Friday, April 7, at 4 p.m. The Lord Mayor will preside, and the president (Mr. Haldane) and others will address the meeting.

MR. F. J. BRIDGMAN, demonstrator in zoology and curator of the zoological museum of the Imperial College of Science and Technology, South Kensington, has been appointed naturalist on the staff of the Plymouth Laboratory of the Marine Biological Association.

ALTHOUGH attacked by a destructive epidemic some two or three years ago, wood-pigeons have of late increased to such an extent that measures are being taken to diminish their numbers. Some letters have appeared in the public Press directing attention to pigeon diphtheria and its risk to man. Pigeon diphtheria, however, has nothing to do with human diphtheria; the micro-organism is quite different, and is probably very minute and a "filter passer."

AN influential deputation from the Royal Institute of Public Health waited on the Presidents of the Local Government Board and Board of Agriculture and Fisheries on March 16 to urge the necessity for appointing a Royal Commission for the purpose of inquiring into (1) the increase of vermin and the steps to be taken for their destruction; (2) the question of what creatures are or are not harmful to man and his industries; and (3) the safety and efficiency of the various viruses on the market and other means advocated for such destruction. Mr. Burns acknowledged the influential nature of the deputation and the importance of their representations, and promised consideration of the matters brought before him.

The Popular Science Monthly for March contains an interesting article, by Dr. Fielding Garrison, on Ehrlich's work on specific therapeutics and on "salvarsan" in

particular. This drug, introduced under the name of "606," is an organic arsenic compound (dioxy-diamino-arsenobenzol), and has an almost specific curative effect on diseases caused by spirillar micro-organisms, such as relapsing fever and syphilis. For the latter a single dose often suffices to cure, whereas the ordinary mercurial treatment must be continued for months.

In a presidential address delivered before the Society of American Bacteriologists, Prof. Veranus Moore pleads for the inclusion of bacteriology in the curriculum of the schools for the masses. He argues that information concerning the cause of fermentations, the storing of nitrogen in the soil, the causes of the changes in food-stuffs, and the etiology of the common infectious diseases, is as important, or the acquisition of such knowledge of as much disciplinary value, as the study of the life-history of the denizens of the deep as now required in many, if not in most, biological courses.

We record with regret the death of Lord Airedale, on March 16, at seventy-five years of age. Lord Airedale, who was perhaps better known under his earlier name as Sir James Kitson, devoted himself to the construction of locomotives suited to the characteristics of the countries for which they were required. He was president of the Iron and Steel Institute from 1888 to 1890. In 1904 he was awarded the Bessemer gold medal "for distinguished services to the iron and steel industries of Great Britain." The University of Leeds conferred upon him the degree of Doctor of Science.

The necessity of a systematic investigation of the prehistoric antiquities in the Balkan Peninsula has been impressed upon English scholars by the important results which have already followed the partial examination of a few of the more promising sites. It is now recognised that this region holds the key to many problems beginning from the early age of Greece and extending to the period of the Byzantine and Bulgarian kingdoms. A new phase of Neolithic culture independent of that of Crete has been identified in Thessaly, and on the Adriatic coast the relationship between the Balkan peoples and those of southern Italy, which is indicated by recent discoveries, needs clearer definition. With the object of exploring these regions, an influential committee of Oxford and Cambridge scholars has been formed, with Dr. A. J. Evans as chairman, Prof. J. L. Myres as secretary, and Mr. Vincent Yorke, The Farringdon Works, Shoe Lane, London, E.C., as treasurer, who invite contributions to a project which is sure to command the approval of all who are interested in the prehistoric culture of the Ægean area.

The annual awards of the Royal Geographical Society have been made as follows. The two Royal medals have been awarded to Colonel P. K. Kozloff, who receives the Founder's for his explorations in Central Asia since 1883, and to Dr. J. Charcot, who receives the Patron's for his expeditions to the Antarctic continent, first in 1903–5, and second in 1909–10. The Victoria research medal has been awarded to Captain H. G. Lyons, F.R.S., who was for many years the Director-General of the Egyptian Survey Department. During his tenure of office he carried through the cadastral survey of Egypt. Captain Lyons is at present lecturer in geography at the University of Glasgow. The Murchison bequest has been awarded to Dr. Wilfred Grenfell for his many years' work in Labrador. The Gill memorial goes to Captain G. E. Leachman, of the Royal Sussex Regiment, for the journey he made last year in north-eastern Arabia. The Back bequest goes to Dr. Arthur Neve, who has resided in Kashmir for many years, and devoted himself to the investigation of the Himalayas. The Cuthbert Peek fund has been awarded to Mr. R. L. Reid, who, during his six years' residence in the northern portion of the Congo State, carefully mapped the whole of the Mobangi River.

We regret to record the death of Dr. Otto Puchstein, secretary of the Imperial Institute of Archæology in Berlin, and one of the leading authorities on classical archæology, especially in its relations to Western Asiatic culture. Dr. Puchstein, who was born in 1856, studied archæology in Strassburg, and it was while he was still at the University that he undertook a careful examination of the Greek inscriptions which had been brought back by Lepsius from Egypt, his resulting dissertation obtaining him his doctor's degree in 1880. His first journey in Kurdistan, which largely determined the trend of his later studies, took place two years later, when he was commissioned by the Berlin Academy to report on the tombs recently discovered by Herr Sester, the engineer. The direct result of this report was the organisation by the Academy of a more important expedition to Asia Minor, on which Puchstein accompanied Prof. Carl Humann and Prof. von Luschan. The work recording the results of the expedition, entitled "Reise in Kleinasien," and illustrated as it is from most successful photographs, is still our principal authority for the remains of Hittite art. In his brochure "Pseudohettitische Kunst," and his suggestive studies of the origin of the Ionic column, he made full use of his wide acquaintance with eastern archæology. Of his other works, the most important were his monograph, in two volumes, on the sculptures of Pergamon, and the work, produced in collaboration with Dr. Robert Koldewey, on the remains of south Italian and Sicilian temples. Since 1885, in addition to other duties, he had held the post of assistant director of the Royal Museum in Berlin.

In *The Fortnightly Review* for March, Mr. W. S. Sparrow attempts to solve the problem how the primitive round house became square and oblong. He traces this transition from the period of the long barrows through the bee-hive houses on the island of Skellig Michael in Kerry. The necessity, as agriculture developed, of forming a winter shelter for cattle, led to the adoption of the oblong shed, the ends of which were supported by the forked tree known as gavel or crutch. This form of shed architecture came gradually to be extended to the round family hut as the needs of social life gave rise to the demand for larger roofed structures, which could not be provided in the circular building, and as the growth of the power of the chief made it necessary for him to sit on a dais at some distance from his retainers. The adoption of the crutch as a roof support naturally led to the practice of doing away with the curved spaces at the sides of the house by flattening the outer wall, which, as in the lake village of Glastonbury, then came to be made of long hurdles.

Some of the papers in ser. 3, vol. xiii., of the *Anales del Museo Nacional de Buenos Aires* (of which we have just received a complete copy), having been already noticed in Nature as they were separately issued, it will suffice to refer to an article on totemism, by Prof. L. M. Torres, which forms the concluding portion of the volume. This contains a long review and collation of the various theories and opinions as to the origin, signification, and effects of the totem cult, together with the author's own views and conclusions.

In the course of a note on the local seals in *The Irish Naturalist* for March, Dr. R. F. Scharff states that a seal which lived for some time in the Dublin Zoological

Gardens, and was taken in Galway Bay in 1895, turns out to be *Phoca foetida*, a species of which there appear to be extremely few previous British records. Dr. Scharff refers to certain dental characters by which the ringed seal may be distinguished from *P. vitulina*, but omits to mention a much more important difference between the two. In the common seal the two branches of the lower jaw form a very short union in front, but in adult specimens of the ringed seal the symphysis is of great length, almost recalling, in miniature, that of a sperm-whale. So great is the difference in this respect between the two species, that it affords considerable justification for Gray's generic separation of the ringed seal.

Two papers on armoured dinosaurs have recently appeared in *The American Journal of Science*. In the first (December, 1910) Mr. R. S. Lull describes the skeleton, or rather the compound skeleton, for it is made up of two individuals, of *Stegosaurus ungulatus*, recently mounted in the Peabody Museum of Yale University. This is claimed to be the first reconstructed specimen with the bones in their proper position, and with the dorsal plates in two parallel rows. A restoration of the external form of this strange reptile is also attempted. In the second paper (February, 1911) Mr. G. R. Wieland suggests that even Mr. Lull's restoration is incomplete, for he claims to have evidence of the existence of a series of low pleural keels in addition to the large dorsal plates. In this communication Mr. Wieland furnishes additional particulars with regard to the dermal plates and other remains described under the name of *Hierosaurus sternbergeri*. These, it is stated, indicate a reptile of about 5 metres in length, and therefore about half the size of Stegosaurus. Possibly they may prove generically inseparable from the previously named Stegopelta.

We have received a copy, bearing the date of May, 1910, of an important memoir, by Dr. O. Abel, on the early Tertiary rhinoceroses of Europe, published as part iii. of vol. xx. of *Abhandlungen der k.k. Geologischen Reichsanstalt*, Vienna. The author adopts the view that the rhinoceros group should be divided into three families, namely, Hyracodontidæ (including Hyrachyus as well as Hyracodon), Amynodontidæ, and Rhinocerotidæ, each of which has undergone divergent development. No fewer than four new generic terms are proposed for the European early Tertiary representatives of the latter, the first two of these being based, respectively, on Cuvier's *Rhinoceros minutus* and Filhol's *Aceratherium minus*, while the other two are established as new species, one from the lignite of Monte Bolca and the other from the Oligocene of Krain. Special classificatory importance is attached to the fourth upper premolar, of which the oldest type is found in Hyrachyus, where the two cross-crests converge on the inner side to form a **U**-like loop. From this we find a gradual transition in the early Tertiary European forms to the modern Rhinoceros type, in which the last molar has become molariform with sundered and parallel cross-crests. Progressive increase in the complexity of the upper molars is likewise noticeable. The proposed emendation of the name *Prohyracodon orientalis* to *P. orientale* is uncalled for.

The fourth volume (185 pp.) of Papers from the Tortugas Laboratory of the Carnegie Institution of Washington contains three contributions:—(1) An account, with text figures, by Prof. H. S. Pratt, of the anatomy of *Monocotyle floridana*, a new monogenetic trematode from the gills of the whip-ray (*Myliobatis freminvillei*). (2) A systematic survey of the trematodes of the Dry Tortugas, by Prof. E. Linton, in which are described, and figured on twenty-eight plates, thirty new genera and eleven new species of previously known genera. The author, while disposed to regard the generic limits proposed by modern helminthologists as being too narrow, is not prepared to suggest, at present, any change in the conception of what should constitute a generic character in the Trematoda; he has chosen to make this large number of new genera, all of which, except three, are represented by a single species, rather than to extend the limits of those already known. (3) Dr. Wayland Vaughan's contribution to the geological history of the Floridian Plateau, which he traces from Lower Oligocene time to the present, includes detailed studies on the geology, topography, bottom deposits, and on the transporting agents and their effects. The account is illustrated with maps, figures, and photographs.

The March issue of *The Naturalist* contains a revised check list of British earthworms, by the Rev. Hilderic Friend. It is nearly twenty years since the previous list was issued, and in the meantime a dozen new species have been discovered by the compiler, and several important varieties. The additions to the former list include *Aporrectodea similis*, Fr., found at Kew last year, and described in *The Gardeners' Chronicle* of August 6, 1910; also *Dendrobaena submontana*, Vej., *Octolasion intermedium*, Fr., from Oxford, *Eophila icterica*, Sav., from Cambridge and Chelsea, *Allolobophora alpina*, Rosa, and *Allurus hercynius*, Mich., from Scotland, and the two interesting worms *Allolobophora hermanni*, Mich., and *Helodrilus oculatus*, Hoffm., which Michaelsen in his "Tierreich" regards as one and the same species. The list contains thirty-five species, besides several varieties, chiefly under the heading of *Eisenia veneta*, Rosa. One entirely new name also appears, but it is at present doubtful whether *Helodrilus elongatus*, Fr., found last year in Cornwall, may not have to be relegated to another group. It may possibly be a Sparganophilus. The author has overlooked the fact that *Bimastus beddardi*, Mich., was found by himself in Ireland, but described as a variety of *B. constricta*, Rosa. As he is preparing a monograph of British earth- and water-worms for the Ray Society, he appeals for help to make his researches complete.

Under the title "The Native Camphor Trees (Cinnamons) of Australia," a paper was read by Mr. R. T. Baker, curator of the Technological Museum, Sydney, before the biological section of the Australasian Association for the Advancement of Science, held in Sydney in January last. In this paper the author endeavours to show that the Australian species hitherto recorded are all endemic, and makes use of anatomical and chemical characters as auxiliary to the morphological characters usually relied upon in discriminating between the species. The appearance of the paper itself will be looked for with considerable interest.

We have received copies of *The American Review of Tropical Agriculture*, a monthly journal, still in its first year of issue, devoted to the agriculture of those tropical countries in which America is particularly interested. It is published in Mexico under the editorship of Dr. Pehr Olsson-Seffer at the price of 15 c., and is intended for scientific and technical communications rather than mere newspaper items. Nos. 5, 6, and 7, which have already come to hand, contain articles on rubber and on the desert rubber-bearing plant, guayule (Parthenium).

Three bulletins received from the Bureau of Entomology of the U.S. Department of Agriculture deal with insect pests of fruit trees. Mr. Hammar describes the life-

history of the codling moth, *Carpocapsa pomonella*, in north-western Pennsylvania. In Bulletin No. 80, part vii., are given details that must be observed in spraying for this moth and for the plum curculio. The details for spraying with paraffin oil and other washes against the scale insects are set out in Bulletin 80, part viii. In another Bulletin (No. 82) are notes on the cucumber beetles, Diabrotica sp. Circular 122 describes the work done in combating the cotton-boll weevil, perhaps the most expensive insect in the States.

WE learn from the Journal of the National Poultry Organisation Society, No. 1, vol. v., that considerable progress has been made during the last twelve months in organising the industry. Indeed, Mr. Brown estimates that we now produce 5,000,000*l*. per annum more eggs and poultry than fifteen years ago. In Ireland particularly great advances have been made, and at the present time the production is considered to be *pro rata* greater than in any other country. Wales and Scotland are, however, only now awakening to the possibilities in this direction. The supply of cheap foreign eggs apparently cannot be relied upon to continue indefinitely, and increased home production is considered necessary if an egg famine is to be avoided.

THE possibility of growing sugar beets in South Africa is discussed by Dr. Juritz in *The Agricultural Journal of the Cape of Good Hope* (No. 5, vol. xxxvii.). As the soils of Cape Colony are better supplied with potash than with other plant foods, in particular, lime, it seemed *a priori* probable that crops rich in sugar could be obtained, and this expectation has been realised. Beets have been grown containing 15 to 16 per cent. of sugar, and comparing very favourably with crops obtained in Germany and the United States. There still remain, however, a number of details to settle before definite steps can be taken to grow the crop on a large scale. All experience indicates that sugar beet is somewhat expensive to produce by reason of the labour and manure required.

THE reduction of timber supply through the destructive action of insect pests forms the subject of recent circulars (Nos. 127, 128, and 129) issued by the United States Department of Agriculture Bureau of Entomology. The annual loss is estimated at about 62,500,000 dollars, but part of this, at any rate, could be saved by utilising damaged timber as early as possible. Indeed, it is considered that the removal of insect-infested timber would do more than anything else to reduce the number of insects and strengthen the control. In Circular No. 125 some of the insects are described, and methods of control are suggested. Bulletin 94 deals with the injury done to chestnut telephone and telegraph poles by wood-boring insects, especially *Parandra brunnea*, Fab., the life-history of which is described in detail. The oak pruner, *Elaphidion villosum*, Fab., is described in Circular 130. It cuts off twigs and small branches, and sometimes even fells young trees.

ON looking through Indian forestry publications and records, it is evident that experience and opinions vary considerably with regard to the best methods for regeneration of forest trees from seed. Considering the great variety of trees and the diversity in soil and climate this is natural, and therefore actual records of observation and experimental seedling plantations are much needed. In the Indian Forest Records (vol. ii., part iii.), Mr. D. O. Witt discusses the sylviculture of *Hardwickia binata*, "anjan," with special reference to the Nimar district of the Central Provinces, and Mr. M. Rama Rao presents a note on the germination and growth of sandal seedlings. Mr. Witt adduces evidence for the contention that successful growth of anjan seedlings depends primarily on a sufficient water supply combined with shade during the hot weather; in addition, preservation is required from grazing, and fire protection is desirable. The paper also contains information with regard to localities, composition, and regeneration of anjan forests.

THE new interpretation, preferred by Prof. E. C. Jeffery, of the structure of certain coals, notably of bogheads, is elaborated, with evidence derived from microscopic sections, in the Proceedings of the American Academy of Arts and Sciences (vol. xlvi., No. 12). On the authority of the two famous French palæontologists Prof. C. E. Bertrand and Mr. B. Renault, the explanation has been accepted that boghead coals are largely composed of colonies of gelatinous algæ, to which the name *Pila bibractensis* has been assigned. This explanation is disputed by Prof. Jeffery, who asserts that the thinner microscopic sections prepared by improved methods reveal the presence, not of algæ, but of spores of vascular cryptogams. It is significant that the spore structure is more pronounced in American and Scotch boghead coals than in the bituminous schists originally investigated by Bertrand and Renault. Prof. Jeffery's interpretation has a wider bearing, inasmuch as it undermines the algal hypothesis of the origin of petroleum.

IN *The Times* of February 28 is a description of the falls of the Mayo Kebi river, furnished by Mr. P. Talbot, whose party are apparently the first Europeans to visit them. Rising in French Equatorial Africa a little south of the tenth parallel, this river plunges down cliffs some 60 feet high, and flows on to join the Benue river on its way to the Atlantic. These cliffs and the gorge below are of granite, and form part of the ridge which here separates the Niger-Benue basin from that of the Shari flowing to Lake Chad.

As a contribution to the hydrography of the basin of the Seine, M. E. Clouzot gives in *La Géographie*, xxiii., 2, an account of the inundations of Paris in the past due to high levels in the Seine. From the sixth century the banks have been submerged from time to time, but it was only in the middle of the seventeenth century that the question of adopting means for mitigating the results of these occurrences was actively discussed, largely owing to the damage wrought by the great floods of 1649, 1651, and 1658

DR GROLL in the *Zeitschrift der Gessellschaft für Erdkunde* for February discusses the imperfect representation of the ocean floor in the light of the comparatively few soundings which are available when the area for investigation is considered. Difficulties in accurately locating points of observation enter into the question also, but even so, if areas are selected where the most detailed surveys have been carried out, the material is sufficient to show that much of the uniformity shown in physical maps arises from over-generalisation or imperfect information.

MR. W. GOODFELLOW, who had to return from the British Ornithological Expedition in New Guinea on account of ill-health, communicated a short summary of his experiences to *The Times* of March 3. He describes the extreme difficulties met with in cutting a way through the dense forest in the low country near the Mimika river. Starting from this river, and pushing inland, it was found eventually that it would have been better to have followed a river lying farther to the eastward, since on reaching the head of the Mimika the expedition had to cut its way eastwards through the forest, a task which

was still in hand when Mr. Goodfellow left. The snow-capped mountain range rose steeply from the country at its foot, and is inaccessible at most points. The heavy rainfall in this range causes the rivers to rise rapidly in flood, by which parties of the expedition were held up for days unable to move. In spite of such obstacles, and the flooded condition of much of the forest region, much careful mapping, both of the Mimika and other rivers, and of a part of the mountain range, has been effected. Collections of birds, mammals, and ethnological objects have arrived in England for study, but a large part of the material obtained has yet to be received, including the reptilian and entomological specimens.

THE Board of Agriculture and Fisheries has just published a memoir of the Geological Survey on the water supply of Sussex (supplement). The memoir contains much new information which has accumulated since 1899, when the original memoir was published. The subject is dealt with under the headings of rainfall, springs, and risks of contamination. Details are given of a large number of wells and borings, together with analyses of waters. A general index, covering the original memoir as well as this supplement, is included. Copies may be obtained, price 2*s*. 6*d*., from any agents for the sale of Ordnance Survey maps, through any bookseller, or from Mr. T. Fisher Unwin, 1 Adelphi Terrace, London, W.C., who is the wholesale agent for the sale of Geological Survey memoirs in the United Kingdom (except in the County of London).

THE "Instructions to the Marine Meteorological Observers of the U.S. Weather Bureau" (third edition), a copy of which has reached us, are very complete, and contain much useful information for general readers interested in meteorology. Some photographs of types of fog in the vicinity of San Francisco are very noteworthy. Instead of several sets of observations required daily by the former log-book, only one observation daily (except in the case of storms) is now asked for, to be taken at Greenwich mean noon. This large reduction in the number of observations required has resulted, as was hoped, in a great increase in the number of observers, which now amounts to about 3000. These daily simultaneous observations taken over the entire sea are first plotted on charts for the study of weather changes as they actually occur; afterwards they are tabulated, according to months, in 5° squares of latitude and longitude, and published in the monthly meteorological charts issued by the Bureau and in the Pilot Charts issued by the Navy Department.

MR. G. W. PIERCE, author of "Principles of Wireless Telegraphy," goes into the question of the best arrangement of the circuits at a wireless receiving station in a paper which appeared in the January number of the Proceedings of the American Academy of Arts and Sciences. The distributed capacity of the antennæ is treated as localised to simplify the calculations, and the results obtained will be sharper and more definite than can be expected in actual practice. The author finds that best resonance may be obtained with two values of the wave-length of the receiving circuits either above or below that of the incident waves. He points out the advantage of a low-resistance detector circuit on account of the superior sharpness of the resonance effect obtained, and considers that what is now required is a low-resistance detector with a high efficiency which shall convert rapid into slow alternate or into direct currents.

The Electrician for March 3 contains an abstract of a paper, presented to the Franklin Institute at Philadelphia by Mr. Carl Hering, in which it is claimed that a conductor carrying an electric current is subjected to a stretching force. In support of this statement, the author describes some of the well-known experiments, or modifications of them, in which a circuit carrying an electric current increases its area if any portion of the circuit is movable. The trough experiment of Ampère, in which a floating conducting bridge connecting two parallel troughs of mercury moves away from the ends of the troughs at which the current enters and leaves, respectively, may be cited as an example. The "pinch" effect, that is, the tendency of a liquid conductor carrying a current to contract in section, which was discovered by Mr. Hering, is given as a further proof of the stretching to which the conductor is subjected. In our opinion, the view taken by *The Electrician* in its leading article on the subject is the more natural one, namely, that the whole of the movements are explained by the repulsion by each other of the magnetic lines of force of the various parts of the circuits.

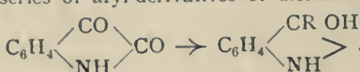
IN connection with the resistance-thermometer method of demonstrating the existence of the Peltier and Kelvin thermoelectric effects described by Mr. Starling in our issue of February 16, Prof. W. König, of Giessen, has directed our attention to two recent papers of his in the *Physikalische Zeitschrift* and in the *Archives* of the Swiss Société de Physique, in which he describes a very simple optical means of demonstrating the existence of the Kelvin effect. The material is a **U**-shaped wire, the bend of which dips into a mercury bath. The electric current passes down one and up the other side of the **U**, and its magnitude is so adjusted that the wire becomes red hot for a short portion of its length. The two red patches are found to be displaced upwards or downwards with respect to each other, according to the sign of the Kelvin effect in the material of the wire. Owing to the complicated nature of the heat losses from such a wire, Prof. König has not been able to make the method quantitative.

WE have received from Messrs. E. Leitz, of Wetzlar, and Oxford Street, London, copies of their catalogues of projection and photomicrographic apparatus. It is an indication of the importance at the present time of such appliances in scientific and educational work that these complete catalogues are compiled and issued separately. Until comparatively recent times such descriptions would have been included in a general catalogue; in fact, even now it seems to be reserved to foreign manufacturers to treat such matters with that thoroughness of which this is a typical example. The apparatus described is, in many cases, designed and constructed on established lines, but in others, particularly in the application of photography to micro-metallurgical work, the arrangements are both novel and ingenious. The ordinary worker is particularly indebted to Messrs. Leitz for introducing a small type of arc lamp, which is of great efficiency considering its small current consumption, may be used on any house supply without special wiring or fitting, and yet gives sufficient light for even the highest power photomicrographic work. Both optically and mechanically the products of the firm now take a high place, and an inspection of the apparatus referred to is sufficient to demonstrate that it is well thought out by those who have practical experience of the requirements of the worker in each particular branch.

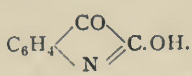
SOLID ammonium nitrite was isolated a year ago by Rây, who showed that small quantities of the salt sublime with decomposition when a dilute solution (0·7 to 2·0 per cent.), prepared by the interaction of silver nitrite

with ammonium chloride or of barium nitrite with ammonium sulphate, is gently heated in a vacuum. It has now been shown by Messrs. Neogi and Adhicâry, of the Rajshahi College, Bengal (Journ. Chem. Soc., February), that the salt may be obtained in fairly large quantities by evaporating and subliming in a vacuum a very concentrated solution of ammonium chloride mixed with sodium or potassium nitrite. The evaporation is carried out in an exhausted distilling flask connected with a condenser and heated by means of a paraffin bath at 50°–60° C., the Geryk pump being worked constantly when the critical moment is reached at which solidification begins. The temperature is then raised gradually to 80°, when the solid nitrite begins to sublime, and forms a thick crust in the upper part of the flask. The salt, which was analysed by a variety of methods, is extremely hygroscopic, but may be kept undecomposed in an ordinary desiccator or in sealed tubes; in a vacuum desiccator the salt is decomposed by the action of the acid on its vapour. Ammonium nitrite is volatile with steam, and does not explode when reheated; vapour-density determinations at 100° showed that the salt had decomposed completely into nitrogen and steam.

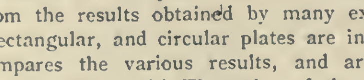
AN interesting contribution to the chemistry of the indigo-group is described in the *Sitzungsberichte* of the Vienna Academy by Prof. M. Kohn, who has acted upon isatin with the Grignard reagent in various forms and obtained a series of aryl-derivatives of dioxindol,



The action is remarkable in that only one of the carbonyl groups is attacked, a result that is perhaps due to the fact that isatin is more correctly represented by the formula



In this connection, it is noteworthy that a similar limitation is found in the case of phthalimide, a closely related substance, which may also be formulated in two ways as



AN article on air-resistance to plane surfaces is contributed to *Engineering* for March 10 by Mr. A. W. Johns. The pressure on plates placed normal to the direction of relative motion has alone been considered. Values of K in the formula $P=KAV^2$, where P is the pressure, A is the area, and V is the speed, have been tabulated in the article from the results obtained by many experimenters. Square, rectangular, and circular plates are included. Mr. Johns compares the various results, and arrives at the following conclusions:—(1) The value of the coefficient K for the same plate decreases as the speed increases. (2) For rectangular plates, the value of K for the same speed and area increases as the ratio between the lengths of the sides increases, and this increase is generally in accordance with Hagen's formula, viz.

$$P=AV^2(0.003+0.00004q),$$

where q is the ratio of the sides of the plate. (3) For similarly shaped plates the values of K are the same at "corresponding speeds"; that is, the "law of similitude" can be applied to the motion of plates through the air. This law asserts that for exactly similar bodies the dimensions of which have a ratio L, exactly similar phenomena attend the motions if the speeds have a ratio $\sqrt{L}$. For example, Dines' result for a 12-inch square plate at 40 miles per hour is $K=0.0029$. For a 60-inch square plate the "corresponding speed" would be $40\sqrt{\frac{60}{12}}=90$ miles per hour, at which speed K would have the same value, viz. 0.0029. Stanton's result for a 60-inch square plate is $K=0.0032$ for speeds between 0 and 25 miles per hour.

BULLETIN No. 44 of the University of Illinois gives account of an investigation of built-up columns under load, carried out by Messrs. A. N. Talbot and H. F. Moore at the University of Illinois Engineering Experiment Station. In the laboratory tests, the amount and distribution of the stress over the cross-section and throughout the length of the channels or other component parts of steel and wrought-iron built-up columns were investigated. The stresses in the lattice bars were also determined. Deformation of the channel members was measured by means of Ames test-gauges mounted on suitable frames. These instruments magnify change of length by means of clockwork operating a hand rotating over a dial. They read directly to 0.001 inch, and by estimation to 0.0001 inch. The deformation of the lattice bars of one of the columns was measured by Ewing's well-known extensometer. The stress distribution both with axial and with eccentric loading was examined. Similar tests were conducted on the columns of a railroad bridge under the load of a locomotive and cars. It was found that considerable local flexural action exists in the channel or angle members of columns. Marked changes in the stress distribution were found at cross-sections short distances apart. Stresses 40 to 50 per cent. in excess of the average stress were measured. The distribution of stress among the various lattice bars was very irregular. The results show the futility of attempting to determine the stresses in the lacing of a centrally loaded column from theoretical considerations. No relation was found between the stresses observed and the stresses computed by any of the usual column formulas. Copies of this bulletin may be obtained gratis upon application to W. T. M. Goss, University of Illinois, Urbana, Illinois.

THE Aëronautical Society of Great Britain will publish immediately, as No. 6 of the Aëronautical Classics, "The Flight of Birds," by G. A. Borelli, which first appeared in 1680. This study of bird-flight has been translated from the original Latin for the first time into English by the editors, Mr. T. O'B. Hubbard and Mr. J. H. Ledeboer, and includes a biographical notice and reproduction of the original diagrams and illustrations. The six "Classics," including Cayley, Wenham, Walker, Lana, Pilcher and Stringfellow, and Borelli, can be obtained separately in paper covers at 1*s*. net, or in one bound volume, with a specially designed cover, at 7*s*. 6*d*. net.

MESSRS. WITHERBY AND CO. have in the press an illustrated volume entitled "Photography for Bird-lovers," by Mr. Bentley Beetham. The book will be a practical guide to the pursuit of bird-photography in all its branches.

OUR ASTRONOMICAL COLUMN.

THE SYDNEY OBSERVATORY.—From an extract from the Sydney *Morning Herald*, reprinted in the March number of *The Observatory* (No. 433, pp. 117–8), we regret to learn that the State Government does not intend to act on the recommendation made by the Public Service Board, two years ago, that the Sydney Observatory should be removed to a more suitable site and properly reorganised. This observatory was founded half a century ago on a site which was then suitable, but which is now enwrapped by the dust and smoke of a great city, and its possibilities otherwise vitiated by the thick haze overhanging Darling Harbour. The instruments are obsolete, and Mr. Raymond, the officer in charge, has to perform his various

duties under great difficulties, and without the status, the authority, or the salary of a Government astronomer. The Public Service Board recommended the removal of the observatory to a more suitable locality, on an eminence not too far from the capital; the appointment of an astronomer with high scientific attainments at a suitable salary (800*l.* per annum and a residence); the re-equipment with modern instruments, including a large telescope of not less than 15 inches diameter; and that steps be taken to affiliate the observatory and the university. Whilst the latter recommendation has given rise to some difference of opinion, there is no dissension on the question of the necessity and advisability of re-establishing the observatory on a proper basis, so that New South Wales shall not be behind other States and countries in the prosecution of astronomical research. But the minds of the Ministers responsible are occupied with "important" matters!

THE SPECTRA OF SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS.—On May 20, 1909 (vol. lxxx., p. 354) we directed attention in these columns to some interesting results, obtained by Mr. Fath at the Lick Observatory, concerning the probable structure of spiral nebulæ and globular clusters as indicated by their several spectra. A second paper by the same author appears in No. 1, vol. xxxiii., of *The Astrophysical Journal*, as a contribution (No. 49) from the Mount Wilson Solar Observatory.

For this later research Mr. Fath employed a spectrograph attached to the 60-inch reflector, and obtained spectra that are but little longer than 3 mm. between λλ 3700 and 5000; despite their small scale, these spectra afford further evidence as to the probable structure of the objects under consideration.

The spectrum of the spiral nebula N.G.C. 650–651 shows seven bright lines, at 373, 387, 397, 434, 486, 496, and 501 $\mu\mu$, corresponding to lines usually found in the spectra of gaseous nebulæ. N.G.C. 4725 gave a spectrum of the solar type with lines at F, G, H, and K, and a spectrum of N.G.C. 4736 is similar, with lines at F, G, 425 $\mu\mu$, 410 $\mu\mu$, H, K, and 387 $\mu\mu$. It is, however, a curious fact that the last-named spectrum differs considerably from one of the same object secured in the earlier research; the Mount Hamilton plate gave what was assumed to be a bright band at 406 $\mu\mu$, and absorption lines at 387 and 400 $\mu\mu$, but as it was not in good focus other plates will be taken with a new specially designed spectrograph which, it is hoped, will be constructed shortly.

Whilst recognising that the evidence is, as yet, slight, Mr. Fath suggests that these results point to a progressive change in the spectra of nebulæ with change of form. Starting with irregular nebulæ, like that in Orion, giving bright-line spectra, we pass to probable spiral nebulæ such as N.G.C. 650–1, where the spectrum shows bright lines and little or no continuous background, thence to planetary nebulæ, such as N.G.C. 6543, giving the bright lines and considerable continuous spectrum. In the fourth type the spiral form is well developed, *e.g.* N.G.C. 1068, and the spectrum, while still showing bright lines, has also a strong continuous spectrum, and contains absorption lines. The last type, exemplified by the Andromeda nebula, gives spectra of the solar type, and the nebula has condensed, at least partially, to stars. This progression indicates star-clusters as the final product.

The spectra of eight globular clusters are almost identical, of approximately the F type, in which the hydrogen series predominates, but, where the spectrum extends far enough, H and K are also found; a line, or band, near 419 $\mu\mu$ is also a common feature. In the Mount Hamilton plates, the Hercules cluster, N.G.C. 6205, gave evidence of the inclusion of more than one type of spectrum, but the more recent work does not support this; more plates with the slit crossing different parts of the cluster must be obtained.

THE DARK BORDERS OF THE MARTIAN SNOWCAPS.—In No. 4472 of the *Astronomische Nachrichten*, M. Antoniadi reverts to the question of the objective reality of the dark bands which appear to encircle the Martian polar caps. In a previous communication he maintained that, if real, they should show on photographs, but Prof. Lowell and others suggested that the brightness of the caps was so intense that the non-appearance of the dark areas might be accounted for by the photographic halation from the brilliant caps. This suggestion was supported by the statement that the photographs taken in America in 1909 showed the caps to be far more brilliant than the "continents." M. Antoniadi now brings independent testimony countering the statement, and maintains that the dark areas are not obliterated by photographic "spreading." In opposition to M. Jonckheere's contention that the dark bands exhibit the perspective they should do, if real, he states that he has never seen it, and reproduces a drawing made by Schiaparelli in 1884 in which the dark band is shown of equal breadth at the middle and at the ends of its major axis.

DOUBLE-STAR OBSERVATIONS.—Nos. 4479–80 of the *Astronomische Nachrichten* contain a large number of double-star observations made by Dr. Doberck at Sutton, Surrey. Most of the observations were made in 1910, and since 1910·13 the Elizabeth Thompson micrometer has been employed. In determining the scale value, corrections have been applied for aberration, refraction, and proper motion, and the final value obtained is $19{\cdot}342'' \pm 0{\cdot}002''$.

No. 6, vol. iv., of the Journal of the Royal Astronomical Society of Canada contains a number of double-star measures made by Mr. Motherwell with the 15-inch refractor of the Dominion Observatory. The work was commenced in 1907, the programme being to measure such pairs in Burnham's General Catalogue as are otherwise neglected or of which the motion seems uncertain.

THE "ANUARIO" OF THE MADRID OBSERVATORY.—The annual almanac published by the Madrid Observatory contains the usual tables and ephemerides for the sun, moon, and planets, and a number of extra tables, in which information as to the aspect of the sky, the azimuth of the pole star, and the passages of certain stars, &c., at given hours, is incorporated. Extensive tables for the calculation of latitude from observations of the pole star are also given, and the volume (1911) concludes with records of the solar and meteorological observations made during 1909.

THE NATIONAL PHYSICAL LABORATORY DURING 1910.

THE General Board of the National Physical Laboratory held its annual meeting at the laboratory on Friday last, March 17, when the report of the executive committee for the year 1910 was formally presented. As usual, a large number of visitors were invited, and were received by Sir Archibald Geikie, president of the Royal Society and chairman of the General Board of the laboratory, and by Lord Rayleigh, the chairman of the executive committee.

The reception this year took place in the buildings of the National Experimental Tank, where the equipment for the experiments to be undertaken on models of ships is now almost complete. The models, 20 feet in length, are cast in clay moulds, and shaped to the correct form by a special machine, which cuts in them a series of horizontal grooves, the operator guiding a tracing point over a corresponding sectional drawing. The wax is then trimmed down by hand to a smooth surface, leaving only the finest trace of the grooves as a guarantee of accuracy. The model is finally measured up on a special measuring table.

The carriage by which the model is towed along the tank weighs some 15 tons, and is driven by four motors designed to enable a speed of 17 miles an hour to be reached for the steady portion of the run. As is well known, the "model" law requires that the speed shall be proportional to the square root of the linear dimensions, and the speed indicated is therefore more than sufficient for the purposes of the tests.

The first report of the advisory committee for the tank appears in the report of the laboratory for the year 1910, and gives some interesting details of the construction, and, in an appendix, of the movements of the walls due to filling. A more complete account of the tank and its equipment, by the superintendent, Mr. G. S. Baker, will be presented to the Institution of Naval Architects at their meeting next month.

The visitors to the laboratory were also able to see the progress which has been made with the new buildings for metallurgy, for which the laboratory is indebted to the generosity of Sir Julius Wernher. In these ample accom-

modation will be provided in the near future for this important and increasing branch of the laboratory's work.

In the physics department, several interesting items of the year's work call for mention. The erection of the Lorenz apparatus, presented by the Drapers' Company as a memorial of Prof. Viriamu Jones, and constructed, by the kindness and generosity of Sir Andrew Noble, at the Elswick works of Sir W. G. Armstrong, Whitworth and Co., is now nearly completed. So far the running has been very satisfactory, the speed remaining constant within 5 parts in 100,000, without regulation, for fifteen minutes. Only the marble cylinders on which the coils are wound now require to be put into place.

In April and May, 1910, Mr. F. E. Smith visited Washington, as the representative of the laboratory, to take part in an international research on the silver voltameter and the Weston normal cell. A full report on the work will shortly be presented to the International Committee on Electrical Standards, which was constituted at the London conference of 1908. The immediate result of the work has been the adoption of the value 1·0183 international volts, in place of 1·0184, as the electromotive force of the Weston normal cell (see NATURE, February 16, p. 508).

The valuable researches on the construction and accurate measurement of inductances, which have now extended over several years, have been continued; an interesting feature of the recent work has been the construction of a resistance box of constant and almost negligible inductance. A comparison of magnetic tests, for total loss, on steel sheet is in progress, in cooperation with the Bureau of Standards at Washington and the Physikalisch-Technische Reichsanstalt.

The electrotechnics division has made investigations into the effect of travelling on supply meters, the heating of lamp sockets, the electric strength of micanite, and into the deterioration, and possible means of protection, of ebonite surfaces, which all present matter of considerable practical value. Tesfs on the heating of cables have been carried out for the Wiring Rules Committee of the Institution of Electrical Engineers. In photometry, the establishment of metallic filament sub-standard lamps has required an investigation which has presented numerous difficulties, and furnished results of much theoretical and practical interest. An important comparison of life tests of glow-lamps was carried out between the laboratory and the Electrical Testing Laboratories of New York, and showed that agreement within 5 per cent. could be expected in such tests.

In the work on the fundamental high-temperature scale, difficulties have been met with in the construction of the reservoirs and tubes of refractory rare-earth materials, which for the time have delayed progress. Valuable work has been done for the International Commission which is dealing with the methods and apparatus for petroleum testing. It is well known that different forms of flash-point apparatus give different values for the flash-point of an oil. Careful exploration of the temperatures below and at the oil surface, and in the vapour, up to the time of flash, has indicated a probable cause of these discrepancies. Some interesting tests have been carried out on the Siemens' calorimetric water pyrometer.

In the metrology division, Mr. J. E. Sears has taken over the charge of the work from Mr. H. H. Jeffcott, who was appointed early in 1910 to the professorship of engineering in the Royal College of Science, Dublin. An interesting feature of the year's work has been the study of the thermal expansion and hysteresis of fused silica, in connection with the new silica standard of length. An account of this work, and of a method employed for counting the rulings of a diffraction grating, has been prepared by Dr. Kaye, and published in the *Philosophical Magazine.*

In the optics division, a tilting table of special design has been installed for tests on clinometers and levels, and metal prisms to serve as standards of angle have been made for use with it, their angles being measured by optical means to a high degree of accuracy.

In the engineering department, a large number of researches have been further advanced, among which may be mentioned specially the investigation into the strength and efficiency of welded joints, the work on alternating stresses of high frequency, shock tests on different forms of screw threads, and the research on the heat transmission and friction of air currents in pipes. In the aëronautics section much interesting work has also been done. The investigations in the air and water channels have dealt with the resistance, stability, and fin area of dirigibles, the lift and drift and centre of pressure of curved surfaces for use as rudders or for other purposes, the resistance of wires, stationary and vibrating, and of ropes, as well as of radiators, model gondolas, &c. The propeller test results have been improved by a careful investigation of the motion set up in the air of the whirling-table shed due to the motion of the whirling arm. The tests of motors entered for the Alexander prize, together with the construction of the necessary testing plant, also formed an important feature of the year's work. The report on these tests was published in November last.

The chief metallurgical research concluded during the year 1910 was that on the aluminium-copper-manganese alloys, which formed the subject of the ninth report to the Alloys Research Committeee of the Institution of Mechanical Engineers. Work on the alloys of aluminium and zinc has since been in progress, and an interesting paper on the theoretical results of this research has recently been communicated to the Royal Society. The investigations into the eutectic alloys, and into the effect of strain on steel at high temperatures, have also made good progress. The planning of the new metallurgical laboratories has, of course, constituted an important part of the year's work.

The section of the report which deals with the work of the observatory department gives details as to the tests of instruments during 1910, and also some particulars of the growth of the Kew verification work between 1880 and 1910. The number of "clinicals" tested in 1881 was about 4000, in 1909 nearly 26,000. The total number of instruments tested since 1880 is more than 673,000. In July last the meteorological work of Kew was transferred to the Meteorological Office, of which Kew will in future be the central observatory.

The complete scheme of reorganisation of the Kew work involves the transference to Teddington of the instrument testing, but for this increased accommodation at Teddington is necessary. The great growth of the work of the laboratory renders also imperative the provision of a building for office and administration purposes. The plans for these additional buildings are already well advanced, and it is earnestly to be hoped that lack of funds will not be allowed to hamper and to curtail the natural development of the important work which the laboratory is called upon to undertake. Figures published in the laboratory report for 1910 show that, out of a total capital expenditure of about 103,000*l.*, 49,000*l.* is due to Government grants, while 54,000*l.* has been received from private sources and as payment for work done; and in view of these figures the committee urge that the request for funds for the much needed extension is one which deserves most favourable consideration from the Treasury.

The preceding paragraph is based on the report of the executive committee of the laboratory to the general board. We understand it was stated at the meeting that an intimation has just been received from the Treasury that the sum of 500*l.* will be placed on the Estimates for 1911–12 towards the cost of the new buildings proposed. The recognition thus afforded of the importance of the work which the laboratory is doing is valuable, but the sum is clearly insufficient to enable the scheme which has been prepared, the estimated expense of which is about 20,000*l.*, to go forward immediately. It is, of course, possible that some other generous donor may be found ready to assist the laboratory in its national work; the electrotechnics building was provided by a gift of 5000*l.* from Sir John Brunner, Mr. A. F. Yarrow has enabled the national experimental tank to be constructed at a cost of 20,000*l.*, and, as already stated, Sir Julius Wernher has recently given 10,000*l.* for the erection of the metallurgy building, while others have given large sums towards the equipment of the laboratory. It is to be hoped that the Royal Society and the governing board of the laboratory may find means which will enable them to provide, without unnecessary delay, the additional buildings and accommodation rendered necessary by the rapid development of the work.

VELOCITY OF EARTH MOVEMENTS CAUSED BY THE MESSINA EARTHQUAKE.

TO the *Reale Accademia delle Scienze di Torino* (1909–10, p. 355) Prof. G. B. Rizzo has contributed an interesting paper on the velocity with which earth movements occasioned by the earthquake which ruined Messina on December 28, 1908, were propagated to different parts of the world. First he gives in detail the observations made with various types of seismographs at 110 stations. These he sums up in tables, which show for the preliminary tremors or P_1, their followers or P_2, and the large waves or P_3, the time taken by them to travel from their origin to these various stations, their average superficial velocity, and the velocities with which the two first types of movement may have passed along paths corresponding to chords. The first results are also shown as curves drawn on squared paper, the two ordinates, respectively, referring to time and distance. The greatest distance considered is 10,000 kilometres, or 90 degrees, although the tables give results to distances exceeding 18,000 kilometres, or 163 degrees. Dr. Rizzo remarks that none of these curves show the flexure near the epicentrum which Schmidt, like Seebach, has used to determine the depth of the hypocentre. The absence of this is taken by Dr. Rizzo to indicate that the origin of the Messina earthquake was very shallow, a conclusion which I do not think will be shared by all seismologists. Many seismologists will, however, agree with him when he bases the idea of a shallow origin upon the comparatively small area of destructivity.

Up to a distance of 1500 kilometres from the epicentre the velocity of all three phases of movements is constant. The inference from this is that up to such a distance the movements are propagated within the crust of the earth, which is estimated as having a thickness of 44 kilometres. From this distance there is a marked increase in the velocity of the first phase, which, however, is not shown by the succeeding phases. The third or large-wave phase he divides into three parts, which he calls L_1, L_2, and L_3. L_1 appears to correspond with the commencement of maximum motion, whilst L_2 is the maximum movement itself. L_3 is the phase which travels the slowest, but if this is to be accepted as a definite and a recognisable phase in a seismogram, there seems to be no reason why we should not also accept very many other phases, which might be indicated by the letters L_4, L_5, L_6, &c.

Of late years, very many hodographs of the character of the one now presented to us by Prof. Rizzo have been constructed. Prof. H. F. Reid has given us an excellent set of time curves relating to the San Francisco earthquake of 1906. Up to a distance of about 55 degrees from the origin these indicate velocities somewhat higher than those given by Prof. Rizzo, but beyond that distance they are very similar. This kind of difference which we find in the work by different seismologists may be due to differences in the manner in which they have interpretated seismograms, but it is much more likely to arise from the non-recognition of all the elements which should be considered when carrying out these particular investigations. J. MILNE.

THE EBRO OBSERVATORY OF COSMICAL PHYSICS.

EL OBSERVATORIO DEL EBRO is situated in Roquetas, near Tortosa, on the river Ebro, Spain. It is in latitude 40° 19′ 14″ N. and longitude oh. 1m. 58·5° E. Its altitude is 51 m. Originally of private origin, it was inaugurated in September, 1904, in connection with the Collège d'Etudes Superieures de la Compagnie de Jesus, Tortosa, with the assistance of many private individuals. In October, 1904, it was recognised by the Spanish Government as an establishment of public utility, and, following this, the Government in 1907 made a grant in aid, which is used to defray the cost of the publication of memoirs and bulletins.

The observatory consists of eight separate buildings, and observations are made in meteorology, solar physics, terrestrial magnetism, electricity, and seismology. An account of the observatory, and also of the observations of the total solar eclipse of 1905, is contained in the first memoir, written by the director, Padre R. Cirera, S.J. The second, third, and fourth memoirs are entitled, respectively, "La Observacion Solar," "La Seccion Magnética," and "La Seccion Electrica."

In the solar section, daily photographs of the sun are taken both in integrated light by photoheliograph and in "K" by the spectroheliograph, which is of the Evershed type. This instrument gives a disc of 62 mm. diameter, the primary image being formed by an objective of 150 mm. aperture and 2 m. focal length.

The areas and positions of spots, on the heliograph pictures, and of the flocculi, on the spectroheliograph negatives, are measured and published in the monthly bulletins.

In the meteorological section, all the usual observations of pressure, temperature, rainfall, winds, and clouds are made with well-known standard instruments three times a day, viz. at 7h., 14h., and 21h.

The observations of atmospheric potential, ionisation, &c., are undertaken by the meteorological department. In the department of geophysics, the observations of magnetic values and variations are made, and hourly values are tabulated. A microseismograph "Vincentini" and a "Grablovitz" pendulum are used in the seismological section. The results of all these observations, both tabular and curves, are published in monthly bulletins.

The first bulletin is for January, 1910, and those for February, March, and April have also been published. The January bulletin contains a short account of the observatory, and accounts also of the methods used in making and reducing the observations.

Having regard to the amount of work which each bulletin represents, and noting the convenience of having all the different elements registered in one volume, the director, Padre R. Cirera, S.J., is to be congratulated on having been able to issue them so shortly after the making of the observations. M.

EMOTION AND MORALS.

ON Saturday afternoon, March 11, a meeting of the British Psychological Society was held at King's College, London, Mr. A. F. Shand in the chair, when Dr. William Brown read a paper on "Emotions and Morals." After a brief survey of the views of earlier writers on the nature and classification of the emotions and their relation to ethics, in which, however, the doctrines of Aristotle and Adam Smith ("Theory of Moral Sentiments") were treated at some length, the author proceeded to discuss the meaning of the terms "passion," "emotion," and "sentiment" in relation to the theories of Ribot, Shand, and McDougall. According to ordinary uses of the term, and also to its etymology, passion would seem to indicate an uncontrollable state of mind, in the form either of an actual emotion or a system of emotional tendencies. Although Shand's employment of the term sentiment to express the conception of "a system of emotional dispositions centred about the idea of some object" would theoretically cover the latter of these two uses, passion seems to be a more appropriate and expressive word to indicate those systems which are uncontrollable by the rest of the mind, and issue, under appropriate conditions, in uncontrollable emotions, *e.g.* "a passion for politics," "a passion for the stage."

The word sentiment, as used in literature, has acquired associations of weakness or placidity which constitutes a slight drawback to its use in scientific psychology to cover all cases included in the technical definition of Shand above-mentioned. "Tender emotion," identified by Ribot and McDougall with the parental instinct, seems to have a wider connotation, and receives more adequate treatment from Shand. In particular, the element of tenderness or pathos present in many æsthetic emotions has little connection with the parental instinct.

The question of "emotions and art" was treated at some length, with special reference to music and the drama. Neither the sensationalistic nor the formalistic theory is adequate as an explanation of music. The ancient Greeks were right in regarding music as "the proper language of the emotions," but it is important to realise that the emotions of music are not, strictly speaking, identical with the emotions of everyday life. They

are analogous to the latter, and this explains the appropriateness of the music to the words in opera, but they really belong to a world of their own and possess a meaning of their own. This is why the music of an opera, even when entirely appropriate to the words, may transcend them in such a way that elements of grossness in the story entirely lose their real "work-a-day" significance in the total presentation. The "Salome" of Strauss is a striking illustration of this.

As regards the psychology of acting, the important statistical investigation carried out by Mr. William Archer, the dramatic critic, more than twenty years ago, is the only work of definite scientific value hitherto produced. Mr. Archer's chief purpose was to test the paradoxical view of Diderot, accepted by Coquelin, but rejected by Sir Henry Irving, that stage emotion should not be real, and that the really first-class actor should be a man of little or no "sensibility." The results showed that in almost all cases of first-class acting in England, not only did the principal signs of real emotion—real tears, blushing, pallor, &c.—occur, but the artists experienced genuine emotion, and often found real emotion from their private lives help them on the stage by mingling with and intensifying their feigned emotion. A state of dual consciousness while acting was found to be common, but not universal.

Mr. Archer adds many further comments of considerable psychological value, and predicts that the subject will be taken up some day by trained psychologists and subjected to an exhaustive discussion.

As an illustration of many of the points raised by Mr. Archer, a letter very kindly written by Miss Ethel Irving as a reply to a query as to her state of mind when playing intense emotional parts, was quoted and discussed, and a general theory of stage-emotion was sketched out and illustrated by a brief description of Miss Irving's recent emotional acting, especially in Henry Bataille's play, "Dame Nature."

GREEK LANDS AND THEIR PEOPLE.[1]

THE establishment by the University of Oxford, from resources supplied by New College, of a new chair for the exploration of ancient history obviously requires, in view of the facilities which already exist for the study of the subject, the justification which is supplied in the inaugural address delivered by Dr. J. L. Myres, the first occupant of the Wykeham professorship.

Dr. Myres justly remarks that, up to the present, the historical course has been too largely devoted to the centuries adjoining the fifth; that it has too jealously confined its researches to the ascertained results of earlier inquiries; that it has discouraged novel methods of investigation; that, in short, its work has become stereotyped and unenterprising. In pointing out a more excellent programme of research, he directs special attention to what may be termed the economic geography and biology of the peoples of the Eastern Ægean. Much has already been done on these lines of research, as in the cartography of Curtius and Kaupert, the examination of battlefields by experts in the art of war, M. Berard's application of sea-lore to Homeric geography, the study of the influence of malaria on the decay of nations, and, lastly, Mr. Huntingdon's investigations of historic meteorology. But much still remains to be done towards exploring the effects of environmental control on the course of history.

The modern Greek race, it is admitted, is largely intermixed with Albanian, Vlach, and Levantine elements. But this fusion of peoples has been continuous from primitive times, so that the history of the Mediterranean area is, as a whole, a history of its invasions, the earliest sea-borne settlers being of the "Mediterranean" reinforced by "Alpine" and "Armenoid" types. But amidst these racial movements, the mountains, the sea, the climate, the flora, have been there from the beginning, and the ethnological situation now depends not so much upon race as upon the prepotent influence of the environment. "No type of non-Mediterranean invader has ever learnt so quickly how to live under Mediterranean conditions as to escape extinction in the process"; the "external environment modifies breed in Man by offering the alternatives of extinction or conformity."

This environment falls into at least three types. First, the prevalence of scrub-lands results in the smallness and discontinuity of the Mediterranean populations; there is little produce from this area, and so "the Greek world is in general a jamless world"; there is little sport except in the mountain region; the cow and the horse are "oasis animals, fed almost by hand." In the forest region the conditions are more propitious, the olive, grape, orange, and lemon providing considerable sources of revenue, while the goat furnishes the milk supply, and the pig is as important as it was in the household of Ulysses. On the other hand, the ubiquitous, restless goatherd is a constant source of political confusion, while the almost exclusive employment of women and children in the collection of forest produce tends towards the growth of the matriarchate.

Secondly come the grasslands, and the relation of the pastoral races to Ægean culture, leading on to the third type, that of the agriculturist, of which the leading characteristic is the crowding into the season between March and July of processes which in more northern lands extend to October, thus leaving one of the busiest seasons of the English year to idle hands "devoted to the devil's work of seasonal war."

The programme of the new chair thus promises an attempt towards the solution of the ethnical problems of the Ægean on new and scientific lines; and though the address of Prof. Myres is not free from certain characteristic foibles of the Oxford school, anthropologists will readily admit that no more competent and imaginative scholar could have been selected to hold the Wykeham professorship.

[1] "Greek Lands and the Greek People." An Inaugural Lecture delivered before the University of Oxford, November 11, 1910, by Prof. J. L. Myres, Pp. 32. (Oxford: Clarendon Press, 1910.) Price 1s. 6d. net.

A DESTRUCTIVE DISEASE OF POTATOES.

A VERY interesting and valuable report on "Wart Disease of Potatoes" has been issued by the Harper Adams Agricultural College. As in the case of previous reports on the same subject, the cost of publication, and also expenses connected with garden trials, have been borne by Mr. Beville Stanier, M.P.

The present report brings together a number of facts which, taken together, show the magnitude of the danger now threatening potato-growing in Great Britain. The comparatively new and most destructive fungous disease known as "Wart Disease" was first reported in Shropshire in 1901 in the Woore district; by 1908 it had assumed alarming proportions in this and other counties —facts which are here emphasised by some admirable maps. The extent to which the disease has now spread in Great Britain is shown by one of these maps, in which a continuous belt of affected counties stretches down the west side of Great Britain from Perth to Glamorgan—no fewer than thirty counties being affected. In the majority of these counties the disease is confined, as yet, to gardens and allotments (the soil of which in some cases has become so contaminated that it is impossible to grow potatoes profitably), but the authors of the report very rightly lay stress on the fact that the risk of the disease spreading from these centres of infection to the fields of farmers is very great. A perusal of this report, indeed, must convince the reader that this disease—which the Vice-president of the Irish Department of Agriculture referred to last year in the House of Commons as "that terrible disease known as 'Black Scab'"—must now actually be spreading to farm-lands in many counties in England and Scotland, as has already happened in Lancashire and Cheshire.

An instance is given of a consignment of seed potatoes (obtained from a county where the disease is very prevalent) which, distributed for use as "seed," gave rise to a number of outbreaks extending over a five-mile radius. The disease is spread also by animals; cases are here recorded where trespassing pigs and poultry have carried the fungus to clean ground and caused outbreaks of the disease. The use of manure from animals (especially pigs) fed on raw "warty" potatoes is a common means of

distribution of the disease with regard to cottage gardens. Workmen who have used spades in digging in infected soil have, when planting potatoes in clean ground, carried the disease on these tools.

Trials of a large number of fungicides have failed to discover any of value. With regard to the behaviour of different varieties of potatoes to the disease, it has been found that all the best and more generally grown varieties, such as Up to Date, British Queen, and allied sorts, are very susceptible. In the "variety tests," however, marked resistance to the disease has been shown by a number of other varieties (Langworthy, Golden Wonder, What's Wanted, &c.).

A clear account of the life-history of the fungus is given, and the new fact reported that the development of warts continues during winter months in stored potatoes. The various plates published with this report are unusually good.

E. S. S.

PROFESSORS AND PRACTICAL MEN.[1]

AFTER allusions to a boyhood spent among practical men, to subsequent university life in Great Britain and Germany, and to the tendency of English men of science with such experience to extol the German system and recommend its adoption, Prof. Smithell's proceeded as follows :—

I am sure that, among the class to which I belong, there is a danger of underestimating the deep-seated powers of Englishmen, of neglecting the true genius of our countrymen, and, in short, of falling into a narrow-mindedness which tends to put us out of sympathy with the people we desire to serve. I think that no one who has studied the history of our industrial development, or has moved observantly among our industrial community, can have failed to be impressed by the great native capacity of the Englishman for practical affairs. The quality is one exceedingly difficult to define. It is very elusive; but it is there—this power of doing things—a power compounded of energy, shrewdness, enterprise, determination, sense of the fitness of things, and knowledge of the intuitive kind. Who does not know the man who, somehow or other, can get hold of the right thing; knows a good thing when he sees it; has an unerring sense of a wrong thing; knows when and where to buy a thing, when and where to sell a thing—who, in short, does not know a good craftsman; and where in the world will you find a better than in England? I honestly believe —nowhere. And yet it may be said that a man who is this, and no more than this, is but a "serviceable savage." I do not agree. He is a man who has developed one set of faculties; but it is a set by no means to be disparaged, by no neglect to be allowed to rust. I honour the man in his workshop who can tell by the look, the feel, the sense of a thing, what it is good for, as well as I can tell by the light of science from the intellectual eminence of a university, for I know that if he is really first-rate in his way, he can assess the value of things for which my science has yet no touchstone. It will be, I dare say, many a long day before an epicure can choose his vintage by chemical analysis; it will certainly be long before science can fully supplant the finely cultivated instinct of the true practical man.

I trust, therefore, gentlemen, that if I, a mere man of science, take upon myself to talk to you about education in relation to your own pursuits, I do not neglect that vastly important element, of education, that development of "mother wit," which comes to man as he fulfils his appointed task of wrestling in the world with men and things for his survival among the fittest. I am not going to emulate the action of a learned acquaintance of mine, who has recently taken upon himself to lecture the pioneers of aviation because they have not delayed their heroic enterprise until the mathematicians have discovered the true theory of stability. Scientific men of this kind, if they had their way, seem to be most likely to achieve the true practice of stagnation. I do not bid you cease to lay mains, to erect gas-holders, or to make gas-fires until we in the august seclusion of our learned halls have worked out the whole true science of heating and illumination.

It is, however, man's prerogative, and it should be his delight, to possess, to use, and to extend the faculty of reason; to increase his power over the forces of nature, and constrain them to his service by a deliberate, a carefully organised, and an unceasing cultivation of the human mind. The true barbarian is the man who is content to do, and does not want to know; and yet how many men are there not, whom no one could call barbarians, who look upon our system of education with a degree of distrust that increases in intensity as their survey passes upwards from the elementary school to the university? This, in my judgment, is a most serious question of the day.

I have long held the opinion that education in England is afflicted from top to bottom with an utterly exaggerated fear of what is called useful knowledge. In that fear, much of a vital kind has been left undone, and much has been given in the name of education which helps its possessor neither to truer wisdom, better work, nobler conduct, nor to greater happiness. The world cries out for educational bread, and it receives only too often an academic stone.

I do not know that I am behind other men in the delight I feel in abstract studies, and I can honestly say it is but rarely I envy another man his larger share of loaves and fishes; but knowledge gathered for what is sometimes called its own sake, and treasured for its own sake, seems to me in great danger of unwholesomeness, and a learned man, who is merely a man of erudition, to be as likely to prove a mischief as he is certain to be a bore.

At the head of our educational system stand the universities. A university is, or should be, in essence a mine and a mart for the highest learning. It was in its origin an adjunct to those callings which made the greatest demand upon the powers of thought. You may put it more picturesquely, no doubt, but it suits my purpose best to use homely terms, for I believe too little stress has been placed upon the real beginning and the original purpose of universities as institutions standing in direct relationship to definite callings. It is, I believe, because our university system has not kept pace with the great changes that have taken place in the character of human occupations, that universities have failed to secure or to retain the sympathy of a large section of the community. The great delay in the development of research and instruction in natural science in the universities led to a corresponding delay in the dissemination of elementary scientific knowledge through our schools, and in consequence we find to-day in the older generation of our more educated citizens, to say nothing of those less educated, a whole legion of men whose knowledge of science would not correspond in terms of their grammar to knowing the difference between a noun and an adjective, in their geography the difference between latitude and longitude, and in their Latin to that between Cicero and Cæsar.

Now I lay great stress upon this lack of the general dissemination of scientific knowledge, because people sometimes say to me that, after all, we have surely had many distinguished men of science in our universities for generations past. It is true; but they were not preparing a market for their wares; they were elaborating in their seclusion something which was utterly mysterious to the average man. Even to-day people come occasionally into my laboratory with the air of men entering a hall of mystery or a chamber of horrors, fearful of what may befall them. Again, people say to me, surely the industrial fruits of scientific knowledge have long been recognised. True again, most palpably true; but how the fruit is related to the knowledge, how the seed is sown, how it is tended, what should be done to nurture the plant, that is not known. It is not known because your educational system did not achieve this one thing for the community—it did not put its victims for a single occasion in their lives in the position of asking a simple scientific question and of faithfully finding the answer by experiment.

Now the portion of knowledge which most completely and vitally interpenetrates our manufactures is natural science, and it has been, I think, an incalculable dis-

[1] Presidential Address to the Society of British Gas Industries, delivered at the annual meeting held in Leeds on March 3, by Prof. Arthur Smithells, F.R.S.

advantage that, whilst these manufactures were advancing by leaps and bounds during the century succeeding the industrial revolution (which I suppose may be dated about 1760) there was no movement in the educational world for a general dissemination of scientific knowledge and skill. During that period several misconceptions took deep root in the English mind. The achievements of Arkwright the barber, Hargreaves the weaver, Crompton the farmer, Watt the instrument maker, Cartwright the clergyman, Stephenson the fireman, Murdock the millwright, and of all that illustrious group—their great and fundamental achievements created an overwhelming belief that the self-taught inventor was destined to be the only important pioneer in industrial discovery, and to this day a young man brought up on a diet of grammar and Samuel Smiles might well despair of contributing anything of moment to the service of industry, unless, indeed, he happened to be exceptionally poor and to have attended no more showy a place of education than a night-school.

If the universities had set themselves to send a current of science through our schools at the time when the direct utility of scientific knowledge and of scientific method was becoming demonstrable in the industrial world, we should, I think, be in a very different position to-day, and our universities would hold a very different place in the esteem of our countrymen. It is this historical retrospect, and the experience of the frantic and wasteful struggles in my own lifetime on the part of the worker to come to terms with the thinker, that have made me realise the dangers that attend academic seclusion, and have left me well content that my lot as a university teacher is cast within ear-shot of the throb and hum of busy workshops.

Of all that we have lost in the course of the events I have described, nothing is more difficult to retrieve than confidence in the practical usefulness of university science. We are suspected at every turn of trying to elude the practical man, and to betake ourselves to studies and impart information the glory of which lies in its detachment from all things mundane and remunerative. We have engendered the suspicion that we are intellectually exclusive, and that we do not understand, or sympathise with, the practical point of view. A better understanding between us is, I think, a matter of the greatest national importance, and it has seemed to me that if a better understanding is to be attained, it is incumbent on the universities to go out so far as ever they can to meet the legitimate claims of the industrial community, and to bring their studies deliberately into the closest possible relationship with the industrial arts.

I think I may claim that in this university we have shown no lack of courage in doing so. In spite of a good deal of academic apprehension and distrust, not always kindly expressed, from outside critics, we have established departments of work for the explicit purpose of furthering the special pursuits of industry, much in the same way and in the same spirit as schools of law, medicine, and theology were established in bygone days.

Another thing, on which I would lay the greatest stress, is that we have secured in the direction of our university as a whole, and of these special departments in particular, the active cooperation of men of business and of representatives of the particular industries concerned. I do not look upon these steps as a gracious concession, still less as a sordid opportunism. I believe they secure the best interests of thought as surely as I hope they will serve the most immediate needs of work.

No one who has studied the history of science can be ignorant of the fact that science has its roots and has gained its greatest impulse in the practical avocations of mankind. Chemistry was born in foundries and pharmacies, and nearly every great advance can be traced to some industrial impulse. I suppose the greatest achievements in chemistry were those of Lavoisier. How did they arise? I believe I am not wrong in saying that it was in the preparation of his prize essay on the best mode of lighting the streets of Paris. Beginning with a consideration of the best form of lamp, the most effective form of reflectors, the most suitable shape of oil-containers, Lavoisier passed to the study of combustion, and finding organic things like oil and tallow too complex to reveal the fundamental nature of the process, he betook himself to simpler things like phosphorus and zinc, and so was led to the train of discoveries which constitute the foundations of modern chemistry. "It was," as M. le Chatelier has said, "this constant preoccupation with practical questions that enabled Lavoisier to escape without effort from the fictions and conventions amid which contemporary chemists were merely marking time."

I have given you but one of innumerable examples to illustrate a truth that we who profess science should never be permitted to forget, and to assure you that I regard the close association of universities with the business world as of enormous advantage to the universities. We have in this, I believe, the true corrective of academic excesses, the best stay for academic frailties; and I believe the good understanding and mutual respect which we may hope to bring about between the leaders in the spheres of labour and of learning will be extended rapidly through the rank and file.

I hope you will find in what I have said so far, the evidence of a desire to acknowledge some of the short-comings of the academic world. But I might well be suspected of having had my head turned by the dignity you have conferred upon me if I left you under the impression that I thought the faults were wholly on one side. In what remains of the time at my disposal I wish to confide in you some of the difficulties of the situation which arise from the other side.

I believe that a very large number of business men go wrong when they enter upon the consideration or criticism of educational affairs by attempting to apply methods and standards and principles borrowed from their own callings, which, however excellent in their proper place, do not apply, or at least do not apply in the same way, to education. Let me remind you, in the very first place, that you can, for example, prepare no balance-sheet of a university. You know how much money comes into the university chest and how much is paid out, but how much a university costs or how much it earns no man can discover. Suppose, for example, in my zeal to find employment for a student, I send you a young chemist who, by his unrestrained ardour or incompetence, misleads you into all kinds of futile extravagance, surely you would debit that to the university. I do not doubt you would. Every care is taken that such things are brought home to us. Suppose, on the other hand, I send you someone, like a former student I met last week, who, by what he had learned here, increased the output of his employer's business by 33 per cent. Should that not be credited to the university if by someone's indiscretion you happened to hear of it? I think so. In a business like ours it transcends the powers of any accountant to effect an audit; you would need a whole secret service of educated spies. You, individually, may give us a thousand pounds in the hope of a return, but you, individually, may get nothing in return—at least in this world—or you may get a return that you cannot trace to its source. No; the essence of university finance is collective investment. It is, to some considerable extent, selective for a locality, and may be made equally so for a single group of interests or industries; but, looking at a university as a whole, it is national, or even international, in its financial ramifications.

If I and many of my colleagues in this and other universities are of some value to this country, I would have you remember that the cost of our education has to a quite considerable extent fallen upon the German tax-payer.

If I say that the students who have gone from our chemical department are collectively earning half a million a year for the firms who employ them, no one can contradict me; and I am tempted to affirm it positively as a counterblast to those hasty financiers who look at our accounts and raise their voice in lamentation over the capital we lay down, without stopping to think of the unrecorded dividends that accrue.

I will take another thing. I think a good business man, whilst anxious to progress and branch out, whilst ready to take risks and go somewhat afield for promising expedients or appliances, is usually very careful not to lose sight of the main current of his affairs, expecting to profit by deliberate methodical plans rather than by totally unexpected accidents.

The same is doubtless true within the pursuit of science

itself, where the object is simply to elucidate a given problem. But when it comes to the contact between science and industry, an entirely new factor appears.

The discovery of the atmospheric burner was not an accident. It arose from the desire of Bunsen to have a gas flame that would not smoke his flasks, and it was contrived by a stroke of genius. But what an accident for you that a man of genius should want a smokeless flame! When I was a student in Bunsen's laboratory there came to it Carl Auer von Welsbach, in the spirit of an unalloyed philosopher, eager to solve some problems about the group of chemical elements that seemed, of all, the most remote from any daily human needs. He noticed the remarkable glow of the mixed oxides when a flame impinged upon them, and so begat the mantle. Again, I say, no accident for him; but, again, what an accident for you, that a man of genius should want to investigate the mystery of rare earths!

I need not ask you where the gas industries would be to-day without these windfalls from the tree of scientific knowledge, the scientific branches of which, be it remembered, wave most vigorously in the upper air. By what definite planning are you to get discoveries of this kind made? The answer is, I think, by treasuring your men of genius and letting them work in the light of their genius. Surely the time has gone by to wonder whether true scientific work, carried on in the spirit of a philosopher by a man of genius with his feet upon the earth, subserves the material needs of humanity. Who is there that will dare to set his finger on any patch of new natural knowledge and say: "This may be edifying, but it is nothing to us"?

When, therefore, you seek to bring science into your service, beware of unduly fettering the minds and discriminating the topics. This seems to be the hardest lesson of all for the Englishman to learn. His very straightforwardness and stern common sense, his businesslike ways, may all conspire to make him unbusinesslike in matters of education and research, to which, believe me, a man must serve a long apprenticeship before he becomes a master craftsman. I will listen eagerly to a business man whilst he tells me what he wants; I will eagerly seek the real knowledge that he has to give; I will eagerly lean upon him in the manifold business of administration; I will eagerly take his money; but when he wants to tell me that I shall teach this and not teach that, that this is useful, the other useless, above all, when he talks as if a well-constituted university should give proficiency in the practice of trades and render apprenticeship superfluous—well, I do not listen to him very patiently, and I say to myself, "Alas, that this man should think himself practical!"

If we on our side come to take a more sympathetic and direct part in bringing science to your service, I plead that you on yours shall show a larger measure of faith, of hope, and, I might almost say, of charity. Do not try to constrain us in our own proper business; do not be impatient of returns. They are sure to come; history has abundantly proved it; but you must freely cast your bread upon the waters.

I have chosen in this address to take what may be called a materialistic view of education, and I am not ashamed. I do not forget that education has many purposes to serve, and that man does not live by bread alone. But without bread man becomes a shadowy or a rebellious being, an ascetic or an anarchist. He must have bread, and he must get it by the sweat of his brow. Englishmen collectively must have work, the nation must have industries, and I take it as no degradation of education to contrive that it shall minister directly to their preservation, their progress, and their prosperity. Rather would I say this—that thereby you dignify labour, refresh the toiler with the fruits of knowledge, and infuse into his daily work the delight of seeing beneath its grime and dust a play of stupendous forces within majestic laws.

Of all the men whom I have known, I could point to no one who, more completely than George Livesey, embodied the finest native strength of the English industrialist. He was one of those men to whom I referred at the beginning of this address, and was bound to succeed independently of all that we call formal education. But you know that he never breathed any such vulgar boast. On the contrary, he believed with all his heart in the worth of all things intellectual. He was eager to draw to his aid all the resources of modern science; he took the broadest, most sympathetic, view of scientific research, and I can, as I have said before, imagine no memorial more acceptable to him than the one which, to our great honour, you have set up in this University. In the inspiring address which he delivered to you from this chair three years ago, he lifted your thoughts to the ethical side of industrial life, and preached to you the chivalry which you knew he had practised in his life. Honest dealing, confidence between man and man, care for the workman, national before personal interests—in short, a large-hearted humanity—these were his topics as they were his qualities. I am not without hope that in the universities, old and new, where knowledge should be cultivated, whatever it may pertain to, in the worship of truth, where young men should see visions, we may help to maintain the fine flower of British industry of which George Livesey was so splendid an example.

VISUAL SENSATIONS FROM THE ALTERNATING MAGNETIC FIELD.

FOLLOWING on the experiments reported by Prof. Silvanus P. Thompson in the Proceedings of the Royal Society, B, 82 (557), pp. 396 ff., it is interesting to note the further research in this subject pursued by Mr. Knight Dunlap, an account of which appeared in *Science* of January 13.

Prof. Thompson subjected the head to the influence of an alternating magnetic field, which was obtained by means of a coil of thirty-two turns of stranded copper conductor having an internal diameter of 9 inches and a length of 8 inches. The coil was supplied with a current the maximum value of which was 180 amperes at a frequency of fifty cycles per second.

On inserting the head in the coil under these conditions, a flickering light sensation was obtained, the sensation being more clearly defined in the peripheral part of the field of vision.

The object of the further experiments by Mr. Dunlap was to ascertain whether or not these sensations were due to idio-retinal light, under the suggestion of the hum of the coil caused by the alternating current.

A coil was constructed which gave a field of approximately the same density as that obtained by Prof. Thompson, and identical results were observed.

In order to ascertain whether the effects are due to idio-retinal light and suggestion, some experiments were carried out in which suggestion was eliminated to the fullest extent.

In these tests the transformer was placed near the coil, so that the hum of the coil was completely drowned by the noise of the transformer. Arrangements were made whereby the current could be switched from the coil on to a resistance, the strength being maintained constant.

The subject's ears were plugged up, and a telephone receiver connected to the transformer was hung on the coil.

Under these conditions it was absolutely impossible to tell by the sound whether the current was on or off the coil; each of the observers was able, however, to identify the flicker with absolute precision when the current was switched on to the coil.

With a field alternating at a lower (twenty-five cycles per second) frequency, it was found that sensation was much more pronounced and intensely disagreeable, the whole visual field quivering as if illuminated by a rapidly intermittent light.

The effect was at all times very intense when the side of the head was presented to the coil, but on looking into the coil it practically disappears. From this Mr. Dunlap infers that the sensation is due to currents induced in the optic pathway; he states that whether these currents excite the occipital cortex directly, or excite the retina primarily, is a matter for conjecture; the fact that the flicker is produced by alterations faster than the fastest flicker from normal light stimulation being, it is stated, no evidence for the non-retinal character of the flicker in question.

It is stated that there was no evidence to show that

there was a definite arousal of visual sensation by the alternating field; the effect appeared more like an alternate intensification and inhibition of whatever sensory process was already in progress. That is to say, the idio-retinal light which is present before the current is turned on is increased and decreased alternately.

A KINETIC THEORY OF GRAVITATION.[1]

EVER since Sir Isaac Newton enunciated the law of universal gravitation, more than two hundred years ago, philosophers have speculated on the nature of that mysterious agency which links every atom of matter in the universe with every other atom. Newton found himself unable to offer any adequate explanation.

Since Newton's time several theories of gravitation have been proposed; but all, of which I am aware, are open to strong objections, and are not considered even promising by physicists.

Study of the nature of gravitation is beset with unusual difficulties, because gravitation is ever with us and about us; it is the one universal phenomenon, and we cannot escape from its influence—cannot obtain any outside point of view.

Gravitation is often described as a feeble force; and so it is, from one point of view. It is difficult to measure, or even to detect, attraction between two small bodies. But when the bodies are of planetary size the aggregate attraction of their molecules is enormous. It is easy to calculate that the attraction between the earth and the moon, which is just sufficient to retain the latter in its orbit, would, if replaced by a steel cable, require that the cable be about five hundred miles in diameter in order to withstand the strain. Between the earth and sun, the cable would have to be nearly as large in diameter as the earth; and attraction between the components of some double stars is millions of times greater than between the earth and sun (Lodge). So tremendous a phenomenon as gravitation, a phenomenon compared with which all others seem trivial, must have a mighty origin.

That gravitation is a phenomenon of the all-pervading æther is beyond reasonable doubt. This is so generally conceded that it need not be argued. But how does the gravitative influence originate? How is it transmitted and maintained? What is the *mechanism* of gravitation? It is the purpose of this paper to attempt an answer to these questions.

Let us consider what happens to a falling body. We know that it gathers kinetic energy from some source, as evidenced by its acceleration; that this energy may do external work or develop heat; that the amount of energy gathered is measured directly by the distance fallen through (within the limits of uniform gravitation), irrespective of the time or rate of falling. When the distance fallen through is of inter-planetary magnitude, and the attracting body large, the gathered energy is enormous, sufficient, if converted into heat, to vapourise the most refractory falling body.

We are here confronted with the question, Whence comes the energy acquired by a falling body? Certainly it was not inherent in the body before the fall, as evidenced by the fact that during unimpeded fall none of the physical or chemical attributes of the body, aside from the acquired motion, changes in the slightest degree.

We have been taught that before the fall the body was endowed with "potential energy of position," which is converted into kinetic energy during the fall. I think "energy of position" is an unfortunate term, because it is so very inadequate. To me it explains nothing. The case is not like that of a flexed spring, where there is internal molecular strain or displacement.

Let us imagine a pound-weight of iron, for instance, raised from the surface of the earth to a point near the moon in a line joining the centres of the two bodies, the point so chosen that the opposing attraction of the earth and the moon shall exactly balance each other, leaving orbital motion out of consideration.

On the surface of the earth the pound-weight had some so-called "potential energy of position," because it was capable of falling into a pit; but in its new position near the moon, this potential energy not only has not been augmented, but has disappeared entirely; the pound-weight, left free to move, remains stationary; and yet we must have expended more than twenty million foot-pounds of energy in overcoming the attraction of the earth and lifting the weight to its new position. This amount of energy would be sufficient to impart to the weight a velocity more than ten times greater than that of the swiftest cannon-ball, or, if converted into heat, would be many times more than sufficient to raise the iron weight to dazzling incandescence and then vapourise it. Now, in lifting the weight, this large amount of energy has disappeared utterly. We cannot believe that the whole or any part of it has been annihilated; it must, in some form, be resident somewhere. I think no one will contend that this energy is resident, in any form, in the cold, motionless pound-weight. I believe it was absorbed by, and is now resident in, the æther through which the weight was raised. Conversely, if this be true, a falling body must acquire its energy from the æther through which it falls. This is a fundamental idea to which I invite attention. Faraday glimpsed it long ago, and others have appreciated it more clearly since his time. But, so far as I am aware, no one has realised its significance.

This view of gravitation implies that the æther is endowed with very great intrinsic energy in some form. Many men of science now hold that the æther is so endowed, and that the amount of this intrinsic energy is enormous. Sir Oliver Lodge ("The Ether of Space") appears to regard this energy as potential in form, and estimates the intrinsic energy of a single cubic millimetre of the æther to be almost inconceivably vast. He says, "All potential energy exists in the ether." Sir J. J. Thomson says, "All kinetic energy is kinetic energy of the ether."

I conceive the æthereal energy involved in gravitation to be kinetic rather than potential, the latter involving strain or stress. Newton, and later Maxwell, assumed that bodies produce a stress in the æther about them of such nature as to account for gravitation, but they were unable to imagine any physical cause for the stress.

All the past theories of gravitation of which I am aware, except the corpuscular theory of La Sage, appear to regard gravitating matter as the seat of the gravitative influence, the surrounding æther, by induced stress or otherwise, acting simply as the medium of transmission. I cannot see that any of these theories accounts for the energy acquired by a falling body.

My own view of gravitation differs from these radically. I believe that kinetic energy of the æther is the fundamental cause of gravitation, and that a gravitating body plays a secondary *rôle* only in disturbing the normally uniform distribution of the æther's energy, in a manner I shall endeavour to explain later.

Let us assume, then, that the æther is endowed with very great kinetic energy normally uniform in distribution.

Kinetic energy implies motion of something possessed of inertia. Now, inertia is a fundamental attribute of the æther. Sir J. J. Thomson holds that all inertia is inertia of the æther. The æther is highly elastic also, which, with its inertia, enables it to possess kinetic energy in wave form, as exemplified in radiation. By the term wave, I mean progressive motion locally periodic; doubtless the æther as a whole is stationary. Hence we may consider the kinetic energy of the æther as consisting in æther waves of some kind.

These waves, vast in aggregate energy, eternal in persistence, without finite source or destination, are imagined as being propagated in straight lines in every conceivable direction. This isotropic distribution of kinetic energy, essential to my theory of gravitation, was, for me, a difficult conception until I reflected that isotropic radiant energy is approximately realised in the interior of any furnace with uniformly heated walls.

Any kind of waves capable of exerting motive action on the atoms or molecules of matter will fulfil the requirements; but I shall first consider the transverse, electromagnetic waves of radiation, because these are the kind of æther waves we are familiar with.

Of course, intrinsic æther waves, if of the radiation kind, cannot be of any frequency at present known to us as radiation, because then all bodies would become heated.

[1] Paper read before the American Association for the Advancement of Science, December, 1910, by Mr. Charles F. Brush.

But we can easily imagine them of such extremely low frequency that the molecules or atoms of matter cannot respond to them—cannot vibrate in unison with them—molecular resonance cannot be established; hence no conversion of the æther's energy *directly* into heat in the ordinary way can take place.

We are familiar with the dissipation or degeneration of the higher forms of energy into heat, and the continual degradation of heat to lower degree; that is to say, less violent molecular vibration and more general distribution. As is well known, it is only through this degradation or running down of natural energy that we are enabled to utilise some of it. Lord Kelvin called this function of energy "motivity" (we now call it entropy), and said the motivity of the universe tends to zero.

We know that ordinary radiation waves in the æther persist indefinitely and without change of frequency or direction until they encounter matter, when they are absorbed and converted into heat, only to be radiated again, usually in longer waves, to some colder body. This degradation of wave frequency continues until we can no longer follow it. I beg to suggest that the ultimate destination of this wave energy is that vast reservoir of kinetic energy intrinsic to the æther. We may liken the waves of radiant energy, which we apprehend as light and heat, to wind ripples on the surface of water, which continually degenerate in wave frequency until they are absorbed into and become a part of the mighty swell of the ocean.

Thus we may, perhaps, regard the æther's intrinsic energy as energy in its lowest form—Kelvin's zero of "motivity." But fortunately we may, and do, get some of this energy back in available form in several ways, as, for instance, when a falling body is arrested and develops heat; some of our wind ripples are then returned to us.

When two gigantic astronomical bodies collide under the influence of gravitation, as sometimes happens, we witness in far distant space the birth of a nebula. The inconceivably vast amount of heat developed by the collision converts both bodies into luminous vapour, which expands with incredible rapidity into the nebulous cloud. This heat energy must in course of time degenerate back into the æther whence it came, though billions of years may be required; and during all this time the energy has "motivity." We may picture the stupendous result of the collision as only a local splash in the æther's mighty ocean of energy.

Having postulated that the æther is endowed with very great intrinsic kinetic energy in wave form of some kind, that the waves are propagated in straight lines in every conceivable direction, *i.e.* the wave energy is isotropic, and that this energy is distributed uniformly throughout the universe except in so far as the distribution is disturbed by the presence of matter, I shall endeavour to explain my conception of the mechanism of gravitation.

For illustration in terms of the known, let us imagine a closed space having uniformly luminous walls of such character that every point on their surface radiates light in all internal directions. The enclosed space may be of any shape, but for the sake of simplicity let it be spherical or cubical, and large, say as large as a lecture-room. The space will be filled with isotropic radiant energy uniformly distributed—any cubic centimetre of space containing as much energy as any other.

Next let us picture a small opaque body suspended anywhere in our luminous space. The body may be of any shape we may imagine an atom or molecule to have; but, again for simplicity, let it be spherical—say a small grain of shot, and let it be located near the centre of the space.

The small body will absorb the light which falls upon it, and will cast a spherical shadow, the depth or intensity of which will vary inversely with the square of the distance from the centre of the body; and the shadow will extend to the confines of the enclosure, however large the latter may be. We cannot perceive the shadow, but we know it is there. It is true that the body will soon acquire the temperature of its surroundings, and radiate as much energy as it receives; but for the purpose of this illustration let us consider only the high-frequency light energy.

As is well known, the æther waves of light will exert a slight pressure on the body. But in the case supposed the pressure will be equal on all sides, and no effort toward translation can result.

Now let us introduce a second small body, similar to the first, and some distance from it. This also will cast a spherical shadow like the first. The two shadows will intersect, and each body will lie within the shadow of the other. In other words, each body will be partially shielded by the other from the æther waves coming from that direction. Hence the light pressure will be less on that side of each body which faces toward the other than on the side which is turned away, and the bodies will be urged toward each other by the excess of light pressure on the side turned away. This excess of pressure will vary with the inverse square of the distance between the centres of the bodies so long as the ratio of distance to diameters remains large.

The æther waves concerned in gravitation cannot, however, be like the light waves I have just used for illustration, because light waves heat bodies on which they fall; and their pressure is almost wholly superficial, it does not reach molecules much below the surface, and hence bears little relation to mass.

But let us substitute for the short and feeble waves of light powerful waves, still of the radiant kind, but of such great length and slow frequency that, as before explained, they do not excite the molecular vibrations which we appreciate as heat, and hence are not absorbed by matter; they pass freely through all bodies, bathing the interior molecules as effectually as those on the surface.

Under these conditions each molecule or atom or unit of a gravitating body will have its own spherical shadow or field of influence, and the gravitative force acting on the body will vary directly with the sum of its units, *i.e.* with its mass.

The spherical shadow which I have pictured as the field of influence of each atom or material unit implies that the atom has caused, principally in its immediate neighbourhood, a diminution of the æther's energy. Let us further imagine this subtracted energy resident in the atom as kinetic energy of translation in many paths, almost infinitesimally short and in every direction, but without collisions, because neighbouring atoms follow *very* nearly parallel paths. We may then picture the collective atoms or molecules of matter buffeted about in every direction by the æther waves in which they are entangled, like a suspended precipitate in turbulent water.

Each atom or molecule may be regarded as a centre of activity due to its kinetic energy of translation, with continual absorption and restitution of the æther's energy, normally equal in amount. The manner in which this molecular activity maintains, in effect, the supposed spherical shadow, requires explanation, which I shall attempt in a future paper.

Of the several components into which the composite motion of each atom can be resolved, that one lying in the direction of an attracting body will be the greatest, because the waves from that direction, being partially intercepted by the attracting body, are weakest, and the atom will be *pushed* in that direction by the superior waves behind it. If free to fall, the atom will continually absorb more energy from the stronger waves behind it than it restores to the weaker waves in front, and will thus acquire additional kinetic energy of translation in the line of fall, measured directly by the number of waves involved, *i.e.* by the distance moved. Conversely, if the atom be forced away from the attracting body, restitution of energy will exceed absorption, and the energy expended in moving the atom against attraction will be transferred to the æther.

It will be seen that gravitation is a *push* toward the attracting body, and not a pull. It is clear, also, that the velocity which a falling body can acquire tends asymptotically to a limit, which is the velocity of the æther waves which push it—the velocity of light, if transverse waves are involved.

I have already intimated that any kind of æther waves capable of imparting motion (not internal vibration) to the atoms of matter will fulfil the requirements of my theory, but have thus far discussed only transverse waves.

Let us now consider longitudinal waves—waves of compression and rarefaction, like sound waves in air and in

elastic liquids and solids. The "spherical shadow" conception which I have employed in connection with transverse waves applies equally well here.

So far as I am aware, longitudinal waves in the æther are unknown, but that such waves have not been observed is not convincing argument that they do not exist.

Assuming, then, that some, or perhaps much, of the intrinsic energy of the æther is embodied in longitudinal waves, we have only to find some motive action of such waves on atoms of matter to account for gravitation. Adequate motive connection may perhaps be effected by the locally alternating flow and ebb—acceleration and retardation of the æther in which the atoms are enmeshed, incident to its wave motion. We have ample reason for believing that the æther does obtain a grip of some sort on the atoms of an accelerating (falling) body and a retarding (rising) body, from which it follows that accelerating and retarding æther, as in a wave of compression, must grip a comparatively stationary atom.

Certain facts of astronomy apparently require that gravitational attraction between bodies, however distant from each other, must, in effect, be instantaneous; that is to say, the line of apparent attraction between them is a straight line joining their centres. I believe my theory meets this condition, but shall reserve discussion of the point for a future paper.

I feel much diffidence in presenting the foregoing rough draft of a theory of gravitation, but I cannot avoid the belief that it contains some germs of truth, perhaps the real key to the great mystery, though, if this be true, I have no doubt used the key clumsily and imperfectly.

If the æther-wave theory of gravitation is, in the main, the true one, it offers some hope of experimental verification. Provided the waves are of one principal frequency, or even of several, we may find something, doubtless of molecular magnitude only, which will oscillate in unison with them so that resonance can occasionally be established and a cumulative effect be obtained sufficient to manifest itself as heat.

In searching for some natural phenomenon of this nature, I thought of the thermal condition of the upper atmosphere as a possible case. The mean molecular velocity of a gas at some temperature, in connection with the mean free path of its molecules at some particular pressure or pressures, may possibly afford the necessary conditions for fortuitous resonance, with development of some slight amount of heat by the increased violence of inter-molecular collisions. I have done much experimental work on these lines during the past year, but, notwithstanding refinement of method and manipulation, the results have thus far been unsatisfactory. The work is still in progress, however, and investigation of other phenomena is contemplated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. C. B. Gardner has been appointed assistant to the superintendent of the Museum of Zoology, and the appointment has received the consent of the Vice-Chancellor.

The special board for biology and geology has nominated Mr. J. F. Gaskell to use the University table at Naples for three months, and Mr. W. O. R. King to occupy the University table at the laboratory of the Marine Biological Association at Plymouth.

On Thursday, April 27, a Grace will be brought before the Senate suggesting that the laboratory of experimental psychology syndicate be authorised to obtain tenders for the erection of a building for the psychological laboratory in accordance with Mr. Jackson's plans, and that the Vice-Chancellor be authorised to sign the contract for the work provided that the total cost does not exceed 4250*l.*

IT is announced in the *Revue scientifique* that Mr. Arthur Krupp has given 50,000 crowns to the Vienna School of Arts and Crafts towards the establishment of an aviation laboratory.

IN connection with the celebration of the centenary of the University of Breslau, Dr. P. Schottlaender has given the University 450,000 marks, the interest of which, says the *Revue scientifique*, is to be devoted to the provision of travelling exhibitions or to the purposes of research.

AT a meeting of the London branch of the Association of Teachers in Technical Institutions, to be held on Saturday, March 25, at the South-Western Polytechnic, Chelsea, S.W., a conference on the organisation of technical instruction, especially in connection with the higher branches, will be opened by Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory.

THE London Inter-collegiate Scholarships Board announces that an examination will be held on May 9 for eighteen entrance scholarships and exhibitions, of an aggregate total value of about 1500*l.*, open to men and women, and tenable in the faculties of arts, science, and engineering of University College, King's College, and the East London College. Particulars and entry forms may be obtained from the secretary of the Board, Mr. A. E. G. Attoe, University College, Gower Street, W.C.

MR. ALEXANDER SIEMENS, president of the Institution of Civil Engineers, speaking at the annual dinner of the institution on March 17, said that the institution proposes to inaugurate a conference on engineering education during the summer with the object of making clear the proper way of preparing young men for the profession of engineering. The passing of examinations is part of what is needed, he pointed out, but not all. The great thing is practical training, so that young men may know how to employ their theoretical knowledge and be prepared to take up any branch of engineering which fate may drive them to. Mr. Siemens hopes that the institution will have an opportunity at the forthcoming Imperial Conference to represent to the Colonies the desirability of recognising the qualifications of its members and of according them uniform treatment throughout the Empire.

THE Home Secretary has appointed a committee to inquire into the constitution, management, discipline, and education of reformatory and industrial schools in England and Wales. The inquiry will include a consideration of the relation of the schools to education committees and other authorities, and the qualifications of superintendents and other officers; variation in the types of schools, and whether further provision is necessary for the proper grading of boys and girls; the suitability of ships for use as schools; the preparation given boys for entry into industrial or other careers, and the training and disposal of girls; the care of boys and girls after leaving the schools and the relation of the schools in this connection to existing institutions for the welfare of young persons. The committee appointed is representative in character, and Mr. C. F. G. Masterman, M.P., is the chairman. Mr. A. Maxwell, of the Home Office, will act as secretary.

THE Board of Education has found it impossible to complete the preparation of the new grant regulations for technical schools, schools of art, and other forms of provision of further education in England and Wales, at as early a date as was suggested in the prefatory memorandum to the regulations issued last August. This being so, the Board feels that to bring new regulations into force by August 1 next would allow insufficient time to education authorities for accommodating their arrangements to the requirements of the new regulations. The grant regulations for 1910 are, therefore, to be continued in force during the educational year 1911–12, and the Board hopes in the course of the coming summer to issue the new regulations, which will not, however, become operative until the educational year 1912–13. The new regulations may thus be in the hands of education authorities a year before they come into force. The Board announces, however, that it will not be necessary similarly to defer the issue or the operation of the new regulations for university institutions. The Board contemplates issuing separate provisions in respect of the educational year 1911–12 for the payment of grant in aid of approved courses provided by university institutions. Any courses so aided will cease to be eligible for recognition under the Board's regulations for technical schools. New regulations for the science and art examinations, the National competition, and the various forms of scholarships and exhibitions given and aided by the Board are under consideration, and it is hoped that

some of the changes involved may be announced in the course of this summer, and may become operative in the summer of 1912.

IN the issue of *Science* for March 3, Prof. Rudolf Tombo, jun., analyses the registration returns for November 1, 1910, of twenty-seven of the leading universities in the United States. Four of the universities show a decrease in their total enrolment of students, viz. Harvard, Iowa, Indiana, and Virginia, as against four in 1909, two in 1908, and five in 1907. If the returns of the number of students for 1910 be compared with those of 1909, we note that Chicago and Michigan have passed Harvard, that Pennsylvania has changed places with Cornell, that Illinois has been passed by Minnesota, California, and Wisconsin, that North-western has passed Yale, and that Johns Hopkins and Virginia have changed places. For the first time in the annals of American universities the 7000 mark has been passed, Columbia having a grand total of 7411 students. Pennsylvania is the sixth university in the States to pass the 5000 mark; Cornell passed it in 1909, Chicago and Michigan in 1908, Columbia in 1907, and Harvard somewhat earlier. The number of students of science in American universities is decidedly smaller than in 1909, and more than half these institutions showed a loss of students in these departments as compared with the previous year. The chief gains were made by Illinois, Yale, and Columbia in the order given. Cornell, Michigan, Illinois, and Yale each enrolled more than a thousand students of engineering. It is noteworthy that the number of undergraduate women students shows a decrease at the majority of the institutions. All the schools of agriculture continue to show an increase in the number of students, and that in connection with the University of Minnesota is still at the head of the list.

SIR ALFRED KEOGH, rector of the Imperial College of Science and Technology, distributed the prizes and certificates to the students of the South-Western Polytechnic Institute, Chelsea, on March 10. In the course of his address he pointed out the deplorable lack of system which exists in the methods of technological education in London. He advocated the creation of a central institution of university rank to which the other institutions might send their most promising students. He also suggested the formation of technological boards of studies composed of the various teachers of technology in London. The annual report of the institute stated that the progress of the work is satisfactory, particularly in the higher branches of science. During the last session twenty-four students attained the London B.Sc. degree, of whom fourteen graduated in honours. Two old evening students obtained the D.Sc. degree. In the Board of Education examinations fourteen obtained honours certificates. A considerable amount of research was completed during the year and contributed to various scientific societies and periodicals. Mr. Hayes Fisher, M.P., chairman of the governing body, alluded sympathetically to the recent loss sustained by the death of Mr. R. C. Antrobus, who for nearly twenty-five years was closely associated with the work of the institute, including ten years' service as chairman of the governing body. Mr. Fisher also stated that they would be shortly in a position to start upon the new buildings, which will furnish accommodation for natural science laboratories and class-rooms, a new physical laboratory, and new and efficient social rooms. After the meeting, the laboratories, workshops, and other rooms were thrown open for inspection. About 1500 visitors availed themselves of this opportunity to inspect the buildings and apparatus.

REPLYING to a deputation from the Trade Union Congress Parliamentary Committee on March 16, Mr. Runciman, President of the Board of Education, dealt with the question of "half-time" pupils in elementary schools. He said the Board of Education has been at work for some time on schemes for linking up continuation classes, and compulsory attendance at continuation classes, with other educational reforms. The Departmental Committee which inquired into the question of "half time" came to the conclusion that the time had arrived for the raising of the half-time age. A Bill will be introduced very shortly into the House of Commons to carry out some of the recommendations of that committee. Continuation-class work ought not, he said, to end at the age of fourteen, but be carried through that period of adolescence in which the boy has lost his habit of learning and has not acquired the proper taste of learning. The Board wishes to keep alive what are called "humanities" as well as technicalities. In trade schools the Board already gives assistance, and it is revising its educational regulation to assist the schools still further. The deputation asked for an inquiry into the question of endowments, but Mr. Runciman, though he has the subject under consideration, said he was unable to promise the appointment of a Royal Commission on the subject. According to *The Times*, the Bill which Mr. Runciman will introduce to deal with half-time attendance will follow the recommendations made by the Inter-Departmental Committee on Partial Exemption from School Attendance, which reported in August, 1909. In reporting against the continuance of the system, the committee recommended that total exemption under the age of thirteen be abolished; that the attendance certificate for total exemption be abolished; that total exemption at the age of thirteen be granted only for the purposes of beneficial or necessary employment; that the ordinary condition for total exemption be due attendance at a continuation class, but that, subject to the approval of the Board of Education, an authority may adopt as an alternative condition the passing of a standard not lower than Standard VI. The committee anticipated that the abolition of partial exemption, coupled with the raising of the minimum age for exemption to thirteen, would necessitate provision being made in the day schools for the instruction of about 22,550 additional whole-time scholars, and would result in an increased cost to the Exchequer to the amount of 22,540*l*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—L. **Doncaster**: Gametogenesis of the gall-fly (*Neuroterus lenticularis*). Part ii. This paper is a continuation of the paper on the same subject published in the Proc. Roy. Soc., B, vol. lxxxii., 1910, p. 88. The previous part dealt with the spermatogenesis and maturation of the eggs of the summer (bisexual) generation. The present part describes the maturation of the eggs in the spring (parthenogenetic) generation. It is found that there are two types of eggs, laid by different females. In one there is a double polar division, by which the somatic number of chromosomes (20) is reduced to 10, and, since the eggs are unfertilised, 10 chromosomes appear in the segmentation divisions. In eggs laid by other females no maturation division occurs; the egg nucleus, after moving to the edge of the egg as if preparing for maturation, sinks in again, and immediately undergoes the first segmentation division. In eggs of this type 20 chromosomes are found in the segmentation spindles, and polar nuclei are absent. Since experiment shows that some females lay only male-producing eggs, others only female-producing, and since male larvæ show the reduced chromosome number (10) in the germ-cells and nervous system, while female larvæ have 20, it is concluded that the parthenogenetic eggs which undergo reduction yield males, those which do not, females.—Sir Thomas R. **Fraser** and Dr. J. A. **Gunn**: The action of the venom of *Echis carinatus*. The minimum lethal dose of Echis venom by subcutaneous injection per kilogram was found to be:—for the frog, 0·009 gram; for the rabbit, 0·0009 gram; for the rat, 0·00075 gram; for the cat, 0·008 gram; and for the pigeon, 0·004 gram. The frog and the cat, therefore, show a relatively high resistance to this venom, the minimum lethal dose for these animals being about ten times that for the rabbit or rat. In the case of Sepedon venom, which may be taken as a typical Colubrine venom, a different ratio of lethality has been found by us for those animals, the cat showing a relatively even higher resistance, but the frog no increased resistance, as compared with the rabbit or rat. This of itself points to an intrinsic difference between the actions of Viperine and Colubrine venoms. The chief effects produced by Echis venom in the animals investigated are hæmorrhages occurring

locally and distally, alterations in the coagulability of the blood, and secondary effects upon the respiration, heart, and central nervous system. The symptoms of experimental poisoning thus very closely resemble those which have been described in cases of Echis bite in man. Echis venom differs from Colubrine venoms in having little or no direct action on the central nervous system or on the nerve terminals in voluntary muscle. It has a direct action in lowering the blood-pressure in mammals by slowing and weakening the heart's contractions; lethal doses also produce a fall of temperature in mammals. The chief toxins in Echis venom, in the order of their potency, are a hæmorrhagin, a substance which alters the coagulability of the blood, and a hæmolysin.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie** (Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10). Further researches on the development of *Trypanosoma gambiense* in *Glossina palpalis*. (1) In the course of the development of *Trypanosoma gambiense* in *Glossina palpalis*, the proboscis does not become involved, as in the case of some other species. (2) A few days after an infective feed the trypanosomes disappear out of the great majority of the flies, but in a small percentage this initial disappearance is followed by a renewed development. (3) After a very short time the flies which have fed on an infected animal become incapable of conveying the infection by their bites, and this non-infectivity lasts for some twenty-eight days, when a renewed or late infectivity takes place. (4) A fly in which this renewed or late infectivity occurs can remain infective for at least ninety-six days. (5) An invasion of the salivary glands occurs at the same time as this renewal of infectivity, and without this invasion of the salivary glands there can be no infectivity. (6) The type of trypanosome found in the salivary glands when the fly becomes infective is similar to the short, stumpy form found in vertebrate blood, and it is believed that this reversion to the blood type is a *sine qua non* in the infective process.—Dr. M. **Haaland**: Spontaneous cancer in mice. The observations recorded have been made upon 300 mice in which cancer had developed spontaneously. The tumours originally observed numbered 350. Many of the mice presented multiple growths. It is important that forty-two tumours had a structure distinct from that of the well-known mammary tumours of the mouse. Spontaneous healing is recorded of undoubted malignant new growths. The reasons have been sought for that preponderance of mammary tumours which is characteristic for the mouse. The physiological demands made upon the mamma by repeated pregnancy and lactation can be excluded, since many of the mice which had been under observation since birth had never littered, and twenty had been completely isolated from possibility of association with a male. The histological examination of the mamma of a large number of old mice, cancerous and non-cancerous, showed the frequency of chronic inflammation combined with hypertrophic and other changes in the epithelium. The latter pass through all stages to definite tumours. The only explanation found for the chronic inflammatory and other changes was the presence of nematodes. Numerous experiments of diverse kind were made to define the parts played by local causes, such as those described above, and by constitutional conditions. All the evidence points to the importance of local causes, *e.g.* chronic irritation, and to the absence of general constitutional changes favourable for the growth of cancer. The part played by the irritant is a mediate one, so that it produces the altered conditions under which either the first departure of the cells from the normal takes place, or permits spontaneously occurring sports of cells to multiply and adapt themselves to a new mode of life as observed in propagated tumours.

Geological Society, March 8.—Prof. W. W. Watts, president, in the chair.—Contributions to the geology of Cyrenaica, by Prof. J. W. Gregory and others. (1) Prof. J. W. **Gregory**: The geology of Cyrenaica. According to the evidence available in 1908 regarding Cyrenaica, the country might be interpreted as a fragment of a mountain-loop, or as a plateau of Miocene rocks. In a journey across the country, the author found that it was a plateau of Lower Kainozoic limestones. These limestones must have been deposited in a clear sea, at depths down to 1000 fathoms. Intervals of shallow sea a[re] indicated by limestone-conglomerates and coral-reef lim[e]stone. The country was uplifted in later Miocene tim[es] and was then part of a wide land which included Cre[te] and occupied the site of the Ægean Sea. This land w[as] broken up by great subsidences, which left Cyrenaica [as] a horst bounded by fault-scarps on the north and we[st]. Cyrenaica may be regarded as part of the western limb [of] the geosyncline of western Egypt.—(2) R. B. **Newton**: Notes on the Kainozoic Mollusca. A number of Mollus[ca] are recognised as belonging to members of the Kainozo[ic] system. The most abundant of the post-Pliocene series [is] *Cerastoderma edule*. Among the Helvetian-Tortonia[n] forms are *Alectryonia* cf. *virleti* and *Strombus* cf. *cor[o]natus*. The Aquitanian shells present a relationship to t[he] "Schioschichten" fauna of northern Italy. Foraminifer[al] organisms occur in these beds, but no nummulit[es]; *Lepidocyclina elephantina*, a good Aquitanian species, [is] found with *Oopecten rotundatus* from Birlibah. The mo[st] characteristic of the Priabonian Mollusca is *Pect[en] arcuatus*. A new species of Æquipecten is describe[d]. Nummulites abound in these rocks. So far as the Mo[l]lusca are concerned, nothing older than Lutetian has be[en] observed.—(3) F. **Chapman**: Foraminifera, Ostracod[a], and parasitic fungi from the Kainozoic limestones [of] Cyrenaica. The Foraminifera are mainly from the Midd[le] Eocene; others belong to the Upper Eocene and to t[he] Aquitanian or Stampian. The most abundant foraminif[er] is *Nummulites gizehensis*. At a higher horizon is [a] nummulitic limestone containing *N. gizehensis*, var. *lyel[li]*. Some limestones at Wadi Umzigga contain *Lepidocycli[na] elephantina*, and are referred to the Aquitanian [or] Stampian. The boring fungus *Palaechyla perforans* occu[rs] perforating Lepidocyclina.—(4) Prof. J. W. **Gregory**: The fossil Echinoidea of Cyrenaica. The Echinoidea a[re] referred to ten species, of which two are new, and one [is] a new variety. The echinoids come from four horizon[s]; the oldest fauna belongs to the Middle Eocene; the Upp[er] Eocene is represented by an unusually early species [of] Amphiope, and by an Echinolampas. Some echinoi[ds] from the Cyrene limestones are of Aquitanian affinitie[s], and others seen in the limestone east of Benghazi a[re] Miocene. The echinoid faunas show that the Eoce[ne] rocks containing them were, as a whole, deposited in [a] sea of moderate depth.—(5) D. P. **MacDonald**: T[he] foraminiferal limestones of Cyrenaica. The microscop[ic] examination of the limestones shows that they are main[ly] composed of organic material, and are free from detrit[al] material. Some of them have been partly dolomitise[d]. Some of the limestones are oolitic.—G. E. **Dibley**: T[he] teeth of the genus Ptychodus, and their distribution in t[he] English Chalk. This paper is an attempt to define t[he] species of the fossil fish genus Ptychodus. Hitherto, o[ur] information as regards Ptychodus has been derived fro[m] associated sets of *P. decurrens* in place and isolated tee[th] of this and other species. The variation in teeth of o[ne] individual is often so marked that, when found separatel[y], they have given rise to the formation of new species. [It] can now be proved that these teeth belong to alrea[dy] known species, and merely represent a phase in variatio[n] in the development of certain teeth of one species. Speci[al] attention has been given to the extreme variation [in] *P. decurrens*, as well as in the equally variable speci[es] *P. polygyrus*, and one new species has been added.

Zoological Society, March 7.—Dr. A. Smith-Woodward, F.R.S., vice-president, in the chair.—Dr. Karl **Jorda[n]** and the Hon. N. Charles **Rothschild**: Some Siphonapter[a] from northern China. This collection of fleas had bee[n] made by Mr. M. P. Anderson, the Duke of Bedford['s] collector, in the province of Shen-si, and containe[d] altogether seventeen species, of which no fewer tha[n] thirteen were new. Some of these were possibly on[ly] geographical developments, but others represented distin[ct] types not very nearly allied to any known species.—F. [E.] **Beddard**: Certain points in the anatomy of the fro[g] *Megalophrys* (*Leptobrachium*) *feae*, based on specimen[s] exhibited in the society's gardens.—F. E. **Beddard**: The spermatophores in earthworms of the genus Pheretim[a] (=Perichæta). These structures had been found in tw[o] species, one of which would be described as new, co[n]tained in a collection of terrestrial Oligochæta from th[e]

Philippine Islands, which had been submitted to him for examination by the director of the Scientific Bureau of the Philippines.—R. **Lydekker**: (1) A rare beaked whale; (2) age phases of the rorqual.—Dr. P. Chalmers **Mitchell**: Longevity and relative viability in mammals and birds, with a note on the theory of longevity. The work was based on a study of the records of the duration of life in the society's gardens of more than 20,000 individual mammals and birds. These were arranged systematically so as to make possible a comparison of the average duration with the maximum duration and what was known or could be inferred as to the potential longevity. Such a method gave a measure of the effect of the conditions of captivity on the duration of life. The memoir discussed some of the results obtained by such a comparison, particularly with regard to the provision of artificial heat. In the note on the theory of longevity, the author briefly reviewed the contributions of Ray Lankester, Weismann, and Metchnikoff, and stated his conclusion that potential longevity was due to constitutional causes, that the constitution was adapted to the average specific longevity, and that the correlation between longevity and reproduction was the reverse of what had been suggested by Weismann.

DUBLIN.

Royal Dublin Society, February 28.—Prof. T. Johnson in the chair.—W. J. **Lyons**: The determination of density, thermal expansion, and volume-change on fusion of waxes. The author described a simple but effective apparatus for the exact determination of the density of liquid and solid fats and waxes at any temperature. The method can be applied to examine the continuous change in volume on change of temperature, and the abnormal volume change on fusion. Some interesting results were shown for beeswax and other waxes.—R. J. **Moss**: A simple form of apparatus for drying substances *in vacuo* at the temperature of boiling water. Finely powdered selenite lost 93·4 per cent. of the total water of crystallisation in one hour by this method, whereas when dried for five hours in the water oven in the ordinary way the loss was only 72·7 per cent.

PARIS.

Academy of Sciences, March 13.—M. Armand Gautier in the chair.—H. **Le Chatelier**: The alterability of aluminium. After some months' use, a marked alteration in the surface of some aluminium utensils was noticed. Photomicrographs are reproduced in the paper showing the nature of the change. The metal developed a crystalline structure, and the crystals tended to become isolated from each other. Some laboratory experiments made with a view to imitate this cellular structure, and to obtain a separation of the grains, have shown that aluminium containing small quantities of calcium lends itself more easily to the reproduction of this structure.—Gaston **Bonnier**, Louis **Matruchot**, and Raoul **Combes**: Researches on the determination of microscopic germs in the atmosphere. Previous researches on this subject have been chiefly directed to the determination of bacteria, and very few have considered the question of the fungi. The apparatus used in this work is described in detail, and a preliminary account of the results is given. The work includes the influence of the culture medium on the development of the organisms, the influence of the surrounding vegetation on the dissemination of the germs, and the influence of the altitude. Amongst other results, the presence of numerous colonies of moulds has been proved in a sample of snow taken on the Pic du Midi at an altitude of 2860 metres. As regards the effect of altitude, the fact already known that the proportion of bacteria diminishes rapidly with the altitude has been confirmed, but, so far as the moulds are concerned, this diminution is less marked, as even at high altitudes numerous mould spores are still found.—A. **Chauveau**: The battle of the visual fields in the stereoscope. A continuation of the work described in an earlier communication (February 27). The results are summarised in ten conclusions, too lengthy for reproduction.—Pierre **Termier**: The age of the green rocks of the Belledonne chain. The green rocks at Tabor are not metamorphosed from the Lias nor from the Trias, and are, indeed, much earlier than the latter.—Paul **Sabatier** and A. **Mailhe**: The catalytic splitting up of esters by certain metallic oxides. Esters may split up catalytically in several directions, forming ketone and carbon dioxide; ethylenic hydrocarbon and water; ketone, carbon dioxide, hydrocarbon and alcohol; acid and hydrocarbon. Examples are given of all these cases, and it is shown that the nature of the acid, the temperature, and the nature of the metallic oxide all have an influence on the course of the reaction.—M. Pavlov was elected a correspondant in the section of medicine and surgery in the place of the late M. Herrgott, and S. Arrhenius a correspondant in the section of physics in the place of the late M. Hittorf.—M. **Nicolau**: The variation in the motion of the moon.—Zoárd **de Geöcze**: Contribution to the quadrature of curved surfaces.—Henri **Villat**: The problem of Dirichlet relating to a circular corona.—Gustave **Dumas**: The resolution of the singularities of surfaces.—C. **Tissot**: The exact determination of the periods of electrical oscillations. A discussion of the limitations of the method described in a previous paper.—C. **Gutton**: A comparison of the velocities of propagation of light and of electromagnetic waves along a wire. The comparison of the velocities of light and electromagnetic waves has hitherto been obtained by the determination of each magnitude separately. By utilising the electrical double refraction of carbon bisulphide, the author makes a direct comparison of the two velocities without measuring either separately. The two velocities were found to be equal within 1 per cent., or within the limits of accuracy of the experimental method employed.—Pierre **Weiss**: Magneton in solid paramagnetic bodies.—Ch. **Moureu** and A. **Lepape**: A spectrophotometric method for the estimation of krypton, especially of the yellow line 5871·12 and the green line 5570·50, and the regular increase in the intensity of the yellow line in a mixture of argon and krypton. This line is in the region of the spectrum in which the eye has a maximum sensitiveness. The results are based on the proportion of krypton in atmospheric argon as found by Sir William Ramsay, but experiments are in progress to make up standard mixtures of pure krypton in pure argon. The minimum amount of krypton that it has been found possible to estimate is about 0·001 cubic millimetre in 4 four cubic centimetres of the krypton-argon mixture.—A. **Lafay**: The utilisation of the acetylene method for the measurement of the velocity of the wind and the study of the aërodynamic field. Comparison of the velocities measured by the vane anemometer and the Pitot tube, respectively, frequently give very discordant results. The method proposed by the author is based on the high refractive index of acetylene. A jet of acetylene is cut off periodically at known intervals of time, and the regularly spaced nebulosities photographed. The results obtained agree better with the indications of the vane anemometer than with those of the Pitot tube.—M. **de Broglie**: The lowering of the differences of the contact potential apparent between metals caused by the removal of the adherent layers of moisture.—M. **Dussaud**: New applications of low voltage bulbs. Some applications of the intense light obtained by tungsten wires in a high vacuum carrying 1 ampere at 15 volts. This lamp, using only 15 watts, may replace for some purposes an arc using 3000 watts.—Maurice **Joly**: Static frequency transformers.—André **Kling**: The influence of catalytic substances in the determination of vapour density. Different results are obtained in a Victor Meyer vapour density tube according to the presence or absence of a layer of calcined sand at the bottom of the tube. The sand in some cases causes a catalytic decomposition of the substance vapourised, and the vapour density is thus found too low. The replacement of the sand by other metallic oxides known to possess catalytic properties has been studied.—M. **Hanriot**: The nature of adhesivity.—Jean **Meunier**: The modification of the mechanism of flame by convergent combustion.—Mlle. E. **Feytis**: The magnetism of some complex salts.—W. Œchsner **de Coninck**: An attempt at the determination of the molecular weight of uranyl. Five determinations are given of the reduction of uranyl chloride, UO_2Cl_2, in hydrogen at a dull heat, the residual UO_2 being weighed.—V. **Auger**: The oxidation of iodine by hydrogen peroxide. In dilute solution and in presence of a trace of chloride, iodine is quantitatively oxidised to iodic acid by hydrogen peroxide. The iodic acid is recovered in a pure state by simple evaporation.—A. G. **Vournasos**: Some definite bismuthides.—E.

Flourent and Lucien **Lévi**: A method for the exact determination of the ash in the analysis of vegetable and animal materials.—MM. **Taffanel** and **Durr**: The comparative study of combustible dusts from the point of view of their inflammability.—Const. A. **Ktenas**: An acid eruption at the centre of the *massif* of the Cyclades.—L. **Gain**: A new species of Monostroma coming from the South American Antarctic region.—MM. **Doyon**, A. **Morel**, and A. **Policard**: The direct extraction of hepatic antirhombine. The case of the rabbit refractory to the action of the peptone.—L. **Grimbert**: The separation of urobiline with its chromogen.—J. **Wolff** and E. **de Stœcklin**: A new mode of preparation of the catalase of the blood and on its properties.—W. **Nicati**: The capacity

$$VC = 0{\cdot}1(11 - V),$$

inverse decimal function of the visual angle.—J. P. **Bounhiol**: A hydrodynamic theory of the pseudo-migrations of the tunny fish (*Thynnus vulgaris*) in the Mediterranean.—J. **Deprat**: The classification of fusiline limestones in China.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vi. for 1910, contains the following memoirs communicated to the society:—

May 2.—D. **Hilbert**: Outlines of a general theory of integral equations.

October 29.—O. **Wallach**: Researches from the Göttingen University chemical laboratory, xxiv.: (1) Reduction of unsaturated cyclic alcohols; (2) reduction of unsaturated ketones.

November 26.—W. **Voigt**: Changes in concentration of the solution of a magnetisable salt in a non-homogeneous magnetic field.

December 10.—P. **Furtwangler**: Researches on the last of Fermat's theorems and the division of the circle.—J. **Yoshikawa**: Boundary-value problems with three parameters.—J. **Yoshikawa**: A theorem in oscillations with two parameters.—E. **Hecke**: Real quadratic groups and automorphic functions.

DIARY OF SOCIETIES.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—A Theory of Asymptotic Series: G. N. Watson.—The Ionization of Heavy Gases by X-rays: R. T. Beatty.—The Variation of the Ionization with Velocity for the β-Particles: W. Wilson.—The Causes of Absorption of Oxygen by the Lungs in Man: C. G. Douglas and Dr. J. S. Haldane, F.R.S.—The Influence of Planets on the Formation of Sun-spots: Dr. A. Schuster, F.R.S.

ROYAL INSTITUTION, at 3.—Giants and Pygmies: Prof. A. Keith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electricity Meters with Notes on Meter Testing: H. A. Ratcliff and A. E. Moore.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 9.—The Sidereal Universe: Sir David Gill, K.C.B., F.R.S.

PHYSICAL SOCIETY, at 5.—(1) A Sensitive Thermo Regulator; (2) Experiments on the Measurement of Electrolytic Resistances using Alternating Currents: Dr. H. F. Haworth.—(1) Oscillatory Currents in Coupled Circuits; (2) Some Radio-telegraphic Apparatus in Use at the City and Guilds (Engineering) College: Prof. G. W. O. Howe.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: James Swinburne, F.R.S.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The New Geography: its Aims and Methods: H. J. Mackinder, M.P.

ROYAL SOCIETY OF ARTS, at 8.—Applications of Electric Heating: Prof. J. A. Fleming, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—State Insurance against Invalidity and Old Age—the Actuarial Basis of the Austrian Method: G. W. Richmond.

TUESDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Explorations of Ancient Desert Sites in Central Asia: Dr. M. A. Stein.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Electrification of a Portion of the Suburban System of the London, Brighton and South Coast Railway: P. Dawson.—*Probable Papers*: The Improvement of Highways to meet Modern Conditions of Traffic: J. W. Smith.—Recent Development in Road-traffic, Road-construction and Maintenance: H. P. Maybury.

WEDNESDAY, MARCH 29.

ROYAL SOCIETY OF ARTS, at 8.—Art Education in Jewellery, Goldsmithing, and Allied Trades: G. B. Heming.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Chemical Dynamics of Serum Reactions: Captain A. G. McKendrick.—Preliminary Note on a Method of Measuring Colour Sensations by Intermittent Light, with Description of an Unfinished Apparatus for the Purpose: Dr. G. J. Burch, F.R.S.—On Variation and Adaptation in Bacteria, illustrated by Observations upon Streptococci; with special reference to the Value of Fermentation Tests as applied to these Organisms: E. W. A. Walker.—On the Inter-relations of Genetic Factors: W. Bateson, F.R.S., and Prof. R. C. Punnett.—A Case of Gametic Coupling in Pisum: P. de Vilmorin and W. Bateson, F.R.S.—On Gametic Coupling and Repulsion in *Primula sinensis*: R. P. Gregory.

ROYAL INSTITUTION, at 3.—Surface Combustion and its Industrial Applications: Prof. W. A. Bone, F.R.S.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—Travelling at High Speeds on the Surface of the Earth and above it: Prof. H. S. Hele-Shaw, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: J. Swinburne, F.R.S.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

PAGE

THURSDAY, MARCH 30, 1911.

ENTOMOLOGICAL STUDIES AND PROBLEMS.

The Hope Reports. Vol. vii., 1908–10. Edited by Prof. Edward B. Poulton, F.R.S. (Oxford: Printed for private circulation by Horace Hart, 1910.)

THIS seventh volume of "Hope Reports" contains publications that have appeared between June, 1908, and June, 1910. It contains a mass of interesting material testifying to active interest taken in entomological studies and problems. The volume opens with an account of Dr. F. A. Dixey's patient and exhaustive investigation into the scent-distributing plume scales of the Pierine butterflies. These plume scales, when present, are found only in the male, and are confined to the upper surface of the wings, sometimes scattered over the general surface of both fore and hind wings, sometimes confined to special areas. An odoriferous secreted substance volatilises, and passing through the scales diffuses, giving an odour characteristic of the species of butterfly. Dr. Dixey passes in review many Pierine butterflies, and describes the structural characters and the various forms and distribution of the scent-scales, and suggests as a result of his research that the scent-scales have a diagnostic value for specific and certainly for generic distinctions. Further, the occurrence and the character of the scales can afford subsidiary evidence to other and more relied-on evidences of affinity.

The never-failing interest in the highly involved phenomenon of protective mimicry is a subject in which British workers—Oxford holding a deservedly foremost place—have won a world reputation, and this explains, and receives justification in, a series of memoirs in this volume of "Hope Reports." Prof. Poulton describes material from Durban, experimentally obtained by Mr. G. F. Leigh from the three mimetic female forms of *Papilio dardanus*, Brown, subspecies *cenea*, Stoll. In dealing with hereditary relationships of the several female forms, evidence is afforded that the proportion of mimetic forms in a locality is due partly to the proportion of, and partly to the relative conspicuousness of, their particular models, and the way is suggested in which the details of mimetic patterns have become adjusted to those of the models. A second paper, by Prof. Poulton, on the mimetic North American species of the genus Limenitis and their models, is followed by "Some Bionomic Notes on British East African Butterflies," by the Rev. K. St. Aubyn Rogers, who, in a long paper, illustrated by four plates, gives many original observations bearing on mimicry and its problems. J. C. Moulton follows with an illustrated account (five plates) of some of the principal mimetic (Müllerian) combinations of tropical American butterflies, and Dr. G. B. Longstaff, in a memoir full of observation, gives many bionomic notes on butterflies from different parts of the world.

In all the above memoirs there is much new information, and additional experimental and observational evidence in favour of Batesian and Müllerian mimicry.

The protective mimicry theory can only justify itself if there be proof that the mimics receive protection from insectivorous enemies, and in this connection attention may be directed to memoir No. 8 of these "Hope Reports," where Mr. Guy A. K. Marshall, in "Birds as a Factor in the Production of Mimetic Resemblance among Butterflies," deals with the debated question of appetite for butterflies among birds. Mr. Marshall gives here a very satisfying and most helpful review, in fifty-three pages, of such appetite and attack, summarising the evidence from world's records.

In memoir 9, "An Account of Some Experiments on the Edibility of Certain Lepidopterous Larvæ," Mr. Eltringham, in experiments where various larvæ were offered to lizards, obtained interesting results with caterpillars of *Boarmia rhomboidaria*. These caterpillars are well known to have a very marked resemblance to ivy twigs, and when motionless may easily be mistaken for twigs. One would have expected that this caterpillar, on being discovered, would prove palatable, whereas these *Boarmia rhomboidaria* caterpillars, fed on ivy, proved most distasteful to lizards. The same caterpillars, however, fed on apple for some days, were taken most willingly by the same lizards.

The systematic side of entomology is represented in the "Reports" by a series of memoirs on the Orthoptera. Three of these are on the Blattidæ by an expert in this family, viz. Mr. R. Shelford, who also writes on "Two Remarkable forms of Mantid Oothecæ." Dr. Hancock, of Chicago, describes Tetriginæ in the Oxford University Museum, and Dr. Achille Griffini, of Genoa, has three papers on the material at Oxford of Gryllacris, a genus of Locustidæ.

Mr. A. H. Hamm describes the courtship of some Empid species, supplementing previous observations by Howlett. The Empidæ, or dance-flies, are predaceous flies, found under trees or among shrubs and by streams. The females of some species were observed to circle round in slow flight, and then to be joined by a male. This male, provided with prey (some previously caught fly), singled out a female, and on the two flies settling for copulation, the prey is found to have been transferred to the female. When the insects, male and female, were netted on the wing before settling, the prey was also found in the net. The female sucks the prey during copulation. Mr. Colman J. Wainwright describes *Setulia grisea*, a Tachinid new to Britain, and then follow notes on the Lepidoptera of the Dale collection in the University of Oxford Museum, by Mr. J. J. Walker; notes on the British dragonflies of the Dale collection, by Mr. W. J. Lucas; and a supplementary list of Coleoptera of the Oxford district, by Mr. J. J. Walker. There is further a series of extracts from the *Proceedings* of the Entomological Society of London, which include numerous interesting bionomic observations.

These memoirs and the reports of the Hope Pro-

fessor of Zoology represent a body of useful and interesting scientific work on which Oxford University can be heartily congratulated. The excellent work done is honourable also to the science of entomology. The laws of life generally apply equally to the lower forms as to the higher, the general problems of heredity, variation, environment, &c., all receive illustration in the insect world, and such studies and observations as are recorded in these "Hope Reports" make a wide appeal to all zoologists and students of biological problems.

CYZICUS.

Cyzicus: Being some Account of the History and Antiquities of that City and of the District Adjacent. By F. W. Hasluck. (Cambridge Archæological and Ethnological Series.) Pp. xii+326; sketch maps. (Cambridge: University Press, 1910.) Price 10s. net.

MR. F. W. HASLUCK, the assistant-director of the British School at Athens, is an archæologist whose knowledge of the bypaths of travel in the Levant is extensive and peculiar. His work, too, has lain among the bypaths of antiquity rather than on its main routes. One of the pleasures of the "Annual of the British School at Athens" for some years past has been the reading of the assistant-director's articles on Frankish Greece and the Ægean Isles in mediæval days. Mr. Hasluck has devoted most of his time to the lands still under Turkish sway, and the present book is a description of what is known of a certain district of Bithynia, of which the centre was the ancient and famous city of Cyzicus.

The author modestly says that his book "lays little claim to be considered as more than a compilation, checked, where possible, by original research." It is more than this, and the original research has been so fruitful and is so genially described that we may wish, perhaps, that Mr. Hasluck had given us only his original research and had left the compilation part out. The book would not have been much smaller, and it would have been more interesting. However, this was not the plan and intention of the book, and no doubt the material derived by Mr. Hasluck from Wiegand and other recent authorities on this part of Asia Minor will be useful to English readers. Wiegand's drawings of the Roman bridge at Sultan Chair, reproduced by Mr. Hasluck, should be of interest to architects. It is a fine and dignified design, worthy of modern adaptation.

The book, part original and part compilation, then, is a very exhaustive monograph on Cyzicus and its district, followed by a very complete bibliography. Mr. Hasluck treats first of topography, in which the results of his own journeys are included, and various new identifications of ancient sites are made. Then he passes to the history, religion, and ancient government of Cyzicus, followed by a very useful index of inscriptions. Mr. Hasluck's photographs are good, and it is a pity there are not more of them. The plans are mostly from Wiegand.

Mr. Hasluck traces the history of Cyzicus from its foundation to the present day, when its site is a waste of meagre and uninteresting ruins, and only the name Bal-kiz preserves the ancient Παλαιὰ Κύζικος In Turkish, *Bal-kiz* means "Honey-Maid," so naturally the Moslem mind identified this *Bal-kiz* with Balkis, the Queen of Sheba, who visited Suleiman the Wise; and the ruined Roman amphitheatre, turned into a castle in Frankish days, was for the Turks Balkis Serai, "the Palace of Balkis." This is one of the many curious little bypaths into which Mr. Hasluck leads us.

The only criticism one has to make is that Mr. Hasluck is too much inclined to rely upon classical authority for his early dates. He accepts the traditional date (756 B.C.) for the foundation of Cyzicus, although there are serious grounds for thinking that this, like all the generally accepted dates of the founding of the oldest Greek colonies, is too early. The traditional year of the second colonisation, 675 B.C., is a more probable date for the first. After all, these dates rest on no more trustworthy grounds than do the Greek dates for the kings of Lydia, which are known to be all wrong. It is odd to find Mr. Hasluck quoting the Eusebian date for Ardys, which is nearly a century and a half too high. Surely, nowadays, we should quote the certain date, known from the contemporary Assyrian records, which place the reign of his father Gyges between 675 and 650. If the "second" founding (which one may think was probably the first and only founding) took place in 675, it can hardly have been due, as Mr. Hasluck considers, to the friendliness of Gyges to Greek colonisation, as in 675 he had hardly been any time upon the throne. However this may be, it is in any case certain that Ardys became king about 650, and Eusebius is really too doubtful an authority even to be mentioned.

In the chapter on religion we find an instance of the same indifference to the results of Oriental research in an adhesion to the old fable of the Sinopean origin of the god Serapis, who is accepted by Mr. Hasluck as originally a native deity of northern Asia Minor (p. 227). Letronne long ago explained the genesis of this story, first circulated by Plutarch and then copied by Tacitus. Sarapis was a purely Egyptian deity, Asar-Hapi, Osiris-Apis, represented at Alexandria in a Greek Zeus-form. The seat of his cult at Memphis seems to have been called *Si-n-Hapi*, "Place-of-Apis," *Sinopion* in Greek. Hence the Sinope story.

However, Mr. Hasluck may be excused for not knowing this fact, notwithstanding that attention was directed to it in an article (by the late Mr. P. D. Scott-Moncrieff) on Plutarch's "De Iside et Osiride," which lately appeared in the "Journal of Hellenic Studies." Classical archæologists should, no doubt, be a little more open than they often are to the reception of Egyptological and other Oriental knowledge; but they cannot be expected to be always aware that some time-honoured Greek belief or other about Oriental matters has long been exploded.

The point is a very minor one in this book, and has

only been expatiated on here in order to point a moral. On his main subject Mr. Hasluck is absolutely trustworthy, and has produced a book which is a credit to himself, to the British School at Athens, and to the University of Cambridge.

H. R. HALL.

RADIOTELEGRAPHY.

Jahrbuch der drahtlosen Telegraphie und Telephonie. Band iii., Hefts 1–6. Pp. 1–634. (Leipzig: Johann Ambrosius Barth, 1909–10.)

FOR those who wish to keep pace with the rapid theoretical and practical progress that is being made in wireless telegraphy, this Jahrbuch is almost indispensable. It contains full accounts of many important researches, abstracts of others, and each number gives a very complete bibliography of the literature on the subject, also a brief account of recent patents.

Glancing through the pages of the present volume, we are impressed with the great improvements that have been made in quantitative measurements. The phenomena dealt with are exceedingly complicated, and as a time interval of one-millionth of a second is long, the inertia of ordinary matter makes it mechanically impossible to follow the rapid changes that take place in an oscillating circuit. Fortunately, the inertia of a kathode stream is practically negligible, and the Braun tube is, in consequence of this, very frequently used in researches on electrical oscillations. This instrument has been utilised by Vollmer in an elaborate investigation of the Poulsen arc (pp. 117–74, 213–50), and by Roschansky in a shorter series of experiments on spark gap resistance (pp. 21–57). From both papers it is evident that much remains to be done before a satisfactory *quantitative* theoretical explanation of the behaviour of arcs and sparks can be given.

There are several papers on the mathematical theory of coupled circuits. Mackü criticises the work of Cohen, discusses the theory of the Fischer method for examining the two waves in coupled oscillators, and gives some approximation formulæ of his own. Berthenod compares direct and inductive coupling mathematically, a problem of particular interest at the present moment.

The problem of long-distance transmission has brought forth many mathematical discussions of the diffraction of electromagnetic waves; one by H. Poincaré appears in the present volume. But it is doubtful whether diffraction plays a very important part; a highly conducting layer of air in the upper regions of the atmosphere would probably be a much more important factor. Very little has so far been published regarding long-distance transmission. Surely a large number of valuable statistics must have been gathered during the past few years at powerful wireless telegraph stations, like Marconi's transatlantic stations, the publication of which would be of the greatest theoretical and practical interest.

Only three papers appear from English men of science—one by Lodge and Muirhead on "The general principles of syntonic wireless telegraphy"; a second by Fleming, "Some quantitative measurements in radiotelegraphy"; and a third by N. Campbell on "The æther."

Wireless telegraphy seems to be very much neglected by the technical colleges in this country; which is most regrettable, as probably in no other branch of engineering is it so essential that an original investigator should have such a very thorough grasp of the fundamental principles of physics.

MODERN ENGINEERING ACHIEVEMENTS.

Engineering of To-day. By T. W. Corbin. Pp. xvi+367. (London: Seeley and Co., Ltd., 1911.) Price 5s. net.

THE author of this book has set himself the task of giving a popular account of the present developments of engineering science, illustrating his text with diagrams and photographs, and, although he has not attempted to make any rash forecasts, yet he has indicated the directions in which future developments are likely to occur.

The first few chapters are devoted to the various sources of power; the steam engine, the gas engine, and hydraulic motors, are all in turn dealt with; then follows a chapter on how this power is transmitted, special attention being devoted to electrical methods. The author next treats of the materials used by the engineer, and modern methods of manufacture. In describing the cantilever system of bridge construction, it is a pity that the author did not adopt the elegant illustration given by the late Sir Benjamin Baker in the course of a popular lecture on the design of the great structure across the Firth of Forth. Ship construction is explained somewhat fully, and a clear account is given of the structural design of most of the leading types of passenger and cargo boats; to ships of war a special chapter is devoted, and, as an illustration of the most modern type of battleship, the author has selected the *Minas Geraes,* recently built by the firm of Sir W. G. Armstrong, Whitworth and Co. for the Brazilian Government. Submarine work and submarine diving form the subject of another chapter.

A short account is given of the filtration of water prior to its distribution to the consumer, but no mention is made of the system of mechanical filtration, which has recently been extensively adopted. As an illustration of a great water scheme, the author has selected the Coolgardie water supply, probably the most daring scheme ever conceived, and one which has proved entirely successful.

Three excellent chapters are those devoted to railways and their work; a description is given of the construction of a modern express locomotive, and details as to the signalling appliances which have to be adopted in order to secure the safety of trains on lines crowded with traffic.

That the book is quite up to date is proved by the

chapter entitled "The Conquest of the Air," in which accounts are given of the latest types of dirigible balloons and of aëroplanes.

In the concluding chapter the author attempts to discuss the engineering of to-morrow. He rightly points out that for many years to come the energies of the engineer will be directed mainly towards the problem of the "utilisation of waste materials and waste forces." The author suggests that in the utilisation of the heat and energy given out by the sun a solution may be found for the difficulty which will arise when the world's coal supply is exhausted. All such proposals are, however, still mere ideas.

The author of this book set himself a difficult task, and he has accomplished it in a satisfactory manner.

T. H. B.

TECHNICAL MYCOLOGY.

Technical Mycology: The Utilisation of Micro-Organisms in the Arts and Manufactures: A Practical Handbook on Fermentation and Fermentative Processes for the Use of Brewers and Distillers, Analysts, Technical and Agricultural Chemists, Pharmacists, and all interested in the Industries dependent on Fermentation. By Prof. F. Lafar. Translated by Charles T. C. Salter. Vol. ii., "Eumycetic Fermentation." Part ii. Pp. x+191–748. (London: C. Griffin and Co., Ltd., 1910.) Price 18*s*. net.

THOSE who worked with the first volume, and the first part of the second volume of Lafer's "Technical Mycology," have waited, with some little impatience, for the appearance of the second part of the latter volume. We have waited our seven years, but have, at last, been rewarded by a work that will be of considerable value to those who are working at eumycetic fermentation, the consideration of which is continued by Prof. Lafar and by a number of experts, each of whom has undertaken to treat a part of this question.

In an introductory section Prof. Lafar himself takes up the general question of yeast nutrition and yeast culture, and brings his subject well up to date. An interesting chapter on variability and heredity in Saccharomycetes may have a much wider bearing than in its application to brewing. Our author points out the importance of the presence of certain mineral foodstuffs, and indicates the possible sources of organic foodstuffs, laying special stress on the sources of nitrogen and on the oxygen requirements of the yeast cell. Here, in connection with Hansen's experiments, he indicates the most favourable conditions for cell reproduction, and the oxygen requirements for both cell-reproduction and respiration. Then follows a description of the effect of copper and its salts, inorganic acids and salts, organic stimulants and poisons, and of alcohol itself upon the yeast cells. Some part of this is repeated by Albert Klöcker, of Copenhagen, who, treating the matter from a somewhat different point of view, gives a very good account of the life-history and variability of the Saccharomycetes, and describes fundamental researches into the life-history of these organisms, temporary variations, and the production of sporing and non-sporing forms, and the development and maintenance of these varieties under various definite conditions. Klöcker also contributes an interesting and full classification of the families Saccharomycetaceæ and Schizosaccharomycetaceæ, which will probably be an accepted classification for some time to come.

In a chapter on the morphology and subdivision of the family Aspergillaceæ, Prof. Carl Wehmer gives an account of the saccharification of starch, acid fermentation, formation of alcohol, and the degradation of proteids and their derivatives by the members of this family. Special articles are also contributed by Prof. G. Lindau on "*Cladosporium herbarum* and *Dematium pullulans*"; by Dr. H. Will on "The Torulaceæ, Pink Yeasts and Black Yeasts"; by Prof. Richard Meissner on "Mycoderma or 'Mother of Vinegar'"; by Prof. H. Müller-Thurgau on "The History, Morphology, and Fermentation phenomena of *Saccharomyces apiculatus*"; by Dr. H. Wichmann on the Monillæ and Oidia; and, in the section devoted to enzymes and enzyme actions of yeast, by Dr. Rudolf Rapp on "Alcoholase," by Dr. Arminius Bau on "The Chemistry of Alcoholic Fermentation and on the Enzymes Decomposing the various Sugars"; whilst Dr. Lafar and Dr. M. Hahn close the work with a chapter on "Endotryptase and Philothion."

The new method of treatment, though it takes away somewhat from the continuity of the story, has many advantages in so far that each part is treated by a special authority, and has thus been brought more fully up to date than would have been possible had Dr. Lafar attempted to cover the whole ground single-handed

The subject-matter of the latter part of the work, dealing with enzymes and enzyme actions of yeast, has passed through such rapid transformation within quite recent years, and is still being so highly developed that it would be impossible for any single writer to keep pace with the enormous numbers of publications that have appeared, and to summarise at all adequately the work thus presented to botanists and chemists. How difficult this would have been may be gathered from the bibliography given at the end of the book, a bibliography which covers more than 130 pages, each page containing from twenty to forty titles of papers. In this volume is contained a very full index of the whole work, without which the reader will have some difficulty in gaining access to the material contained in the earlier published volume and part. The translator has done his share of the work well; the illustrations are good, and the general appearance of the book corresponds very closely to that of the earlier issues. The completed work is far more valuable than it is in the individual parts, and we strongly advise those who take an interest in the technical subjects dealt with in this part to read it, and then keep it for reference alongside the others.

COLLOID CHEMISTRY.

An Introduction to the Chemistry of the Colloids. A Compendium of Colloidal Chemistry for Students, Teachers, and Works Managers. By Dr. V. Pöschl. Translated from the second, enlarged, German edition by Dr. H. H. Hodgson. Pp. iv+114. (London: C. Griffin and Co., Ltd., 1910.) Price 3*s*. 6*d*. net.

THIS short work is well described in its title as a compendium of colloidal chemistry. Struck by the growing importance of this branch of chemical science, the author has endeavoured to provide a brief summary of the chief characteristic properties and modes of preparation of colloids, as well as to indicate some of the more important phenomena in the production of which colloidal substances are concerned.

The chemical methods for the preparation of colloidal solutions of the hydroxides, sulphides, and metals are described in some detail, together with the properties of the resulting hydrosols, special attention being paid to gold and silver, the study of which has done so much to advance our knowledge of the colloids. The electrical methods, due to Bredig, for the production of metallic hydrosols are also well described, whereas the precipitation methods by which colloidal solutions of sodium and barium salts have been obtained are not mentioned.

The character of the work is incompatible with much discussion of the numerous knotty points which must inevitably arise in any account of the various theories of the colloidal state, but a clear description of these theories is given, great stress being laid on the positive evidence afforded by the ultramicroscope that colloidal solutions are not homogeneous. Attention is also directed to the important fact that many substances, a list of which is given, are known both in the crystalline and colloidal forms, and that the colloidal state is not necessarily a property only of substances possessed of a large molecule and complex chemical constitution, but may also be associated with quite simple substances, the nature of solvent, or, as it is better termed, the dispersion medium, being frequently the deciding factor.

Perhaps too little stress is laid on the electrochemical relations of colloids, and the important subject of the mutual precipitation of colloids of opposite electrical sign is dismissed in a single line.

The concluding sections on the importance of colloidal chemistry in various branches of chemistry and in other sciences indicate very clearly how much assistance these are deriving from the realisation of the fact that many familiar phenomena can only be adequately understood in the light of our knowledge of the colloids.

On the whole, it may be said that the purpose of the author in compiling this account of the colloids has been fully realised, and that the reader will gain a good idea of many of the points of interest connected with this difficult and important subject.

A. HARDEN.

OUR BOOK SHELF.

An Introduction to the Study of Metallurgy. By Sir W. C. Roberts-Austen, K.C.B., F.R.S. Sixth edition, revised and enlarged by F. W. Harbord. Pp. xv+478. (London: Charles Griffin and Co., Ltd., 1910.) Price 18*s*. net.

THE appearance of a new edition of Sir William Roberts-Austen's "Introduction to the Study of Metallurgy," which has been out of print for some time, is to be heartily welcomed, as no other book adequately fills its place in metallurgical literature. Since its first publication there have been vast advances in pyrometry, metallography, and in metallurgical processes, advances which were only partially dealt with in succeeding editions. In this the sixth edition special attention has been given to the results of recent research and metallurgical progress; the chapter on pyrometry has been rewritten, a new chapter on metallography has been prepared, and in the chapter on furnaces, descriptions and illustrations of typical modern furnaces and appliances have been introduced to replace those which are no longer in general use. This chapter also contains an extremely useful account of the construction, modes of working, and uses of the three chief types of electric smelting furnaces.

A valuable addition, the thermal treatment of certain industrial alloys, has been made to chapter iv., which in previous editions was confined almost entirely to the thermal treatment of steel.

The book is intended to give a systematic course of study in the fundamental principles on which metallurgical processes are based, and the success of their various operations depend; and for this it is admirably adapted. It will be conceded by all that without this knowledge the difficulties and irregularities which arise in metallurgical practice can be, if at all, but imperfectly contended with.

The information which is given on the subjects dealt with, although necessarily brief in some cases, is set forth with remarkable clearness, and is thoroughly trustworthy and up to date.

The new edition is an excellent piece of work, and Mr. Harbord deserves the congratulations of metallurgists for having brought this valuable text-book into touch with the times. It is indispensable not only to students, but to all who are engaged in practical metallurgical work. W. G.

Untersuchungen über die Zoogeographie der Karpathen. (Unter besonderer Berücksichtigung der Coleopteren.) By Karl Holdhaus and F. Deubel. Pp. vi+202, and map. (Jena: Gustav Fischer, 1910.) Price 8 marks.

IN this important and carefully written work Prof. Holdhaus analyses chiefly the Coleoptera of the Carpathians, with special reference to the influence of the Glacial period on the Alpine fauna of Europe. We may perhaps quote a few words from his introduction to make his starting point clear, though possibly the case is a little overstated, in view of the circumpolar fauna and flora:—"During the Glacial period all life was annihilated in northern Europe. The animals at present inhabiting north Europe are post-Glacial immigrants. The remarkable impoverishment and monotony of the northern fauna—especially the absence of a typical mountain fauna in Fenno-Scandia—seems inexplicable except from this point of view. In central and southern Europe the influence of the Glacial period is chiefly visible in the mountain fauna."

Prof. Holdhaus commences by discussing the geological history of the Carpathians, and their climate and vegetation. Then he proceeds to discuss the distribution of the Coleoptera of the Carpathians, and the districts which they inhabit, the age and origin of this fauna, and how far it has been influenced by

the Glacial period, especially as compared with the fauna of the Alps. Another chapter deals with the distribution of mammals, reptiles, amphibia, mollusca, &c., in the Carpathians, followed by lists of Coleoptera (by Holdhaus and Deubel) found in different districts in the Carpathians, with notices of the surroundings. The map illustrates the glaciation of the eastern Alps and Carpathians during the Ice period, and the range of the blind mountain beetles. These beetles are a specially interesting group, of limited range, in the Austrian Alps. Some of them are cave species, while others inhabit the open.

Many interesting subjects are discussed by Prof. Holdhaus, which we have no space to allude to, but he has not forgotten to take account of fossil and amber Coleoptera, and his remarks on what he calls "Massifs de refuge" (districts south of the Alps to which he believes the mountain species retreated during the Glacial period) also seem to deserve special attention.

Mosses and Liverworts. An Introduction to their Study, with Hints as to their Collection and Preservation. By T. H. Russell. New and revised edition. Pp. xvi+211+xiii plates. (London: Sampson, Low, Marston, and Co., Ltd., 1910.) Price 4*s*. 6*d*. net.

THE speedy demand for a second issue of Mr. Russell's book testifies to its value and usefulnes as a guide to the study of mosses and hepatics. The introductory portion is all that can be desired, and the student who conscientiously masters this portion will be in a position to pass on to more advanced books dealing with the same subject. The author lays much stress on the point that he is specially anxious to use simple language, fearing that scientific words might act as a deterrent to the study. With this frequently expressed idea we do not quite agree; the true value of a scientific term consists in the fact that, when once grasped, it stereotypes the particular structure in a single word, whereas a sentence in English may convey but a very vague idea of the structure in question. As an example, the term *archegonium* defines a definite structure, which is said to be "the fruit-bearing organ," which it certainly is not. The species given as examples are well chosen, and cover all the structures peculiar to mosses and hepatics.

The detailed account of habitats, and the stress laid on their importance, are features to be commended, as too frequently the student is encouraged to snatch a fragment from anywhere, put it into a tube containing methylated spirit, and only commence serious study when viewing it under a compound microscope. The chapters on collecting, storing, and the preparation of mounted specimens for microscopic work are very full, and are obviously the outcome of much practical experience.

Thirteen whole plates of excellent figures add much to the value of the book, which can be confidently recommended as a stepping-stone to the study of mosses and hepatics.

The Social Guide, 1911. Edited by Mrs. Hugh Adams and Edith A. Browne. Pp. xxxviii+252. (London: A. and C. Black, 1911.) Price 2*s*. 6*d*. net.

INFORMATION is given in this work of reference not only about occupations for leisure days and hours, but also concerning more serious pursuits. The diary with which the volume begins includes the meetings of the Royal Geographical Society and of the British Association among scientific societies, and the anniversary dinner of the Royal Society. Though it is sometimes a little difficult to understand the principle of selection for the contents of the volume, we notice the activities of the Royal Institution, the Royal Society of Arts, and the Zoological Society are described.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Kinetic Theory of Gravitation.

THE subject of Mr. Brush's article in NATURE of March 23 (p. 129) is certainly of profound interest, and will continue to be so until the problem as to the nature of gravitation is solved. Meanwhile, a few questions raised are comparatively simple. Anyone asked, Where lies the energy of a raised weight? must surely reply, "In the æther," *i.e.* in the medium, whatever it is, that is driving the weight down towards the earth. A critic who either doubts or asserts this will not be confused—as Mr. Brush suggests he will be—by the suggestion that the weight might be raised so high as to reach the neutral point between earth and moon—a suggestion which carries with it the tacit questions, "Where is the energy now?" and "What has become of the work done?"—for this case is no more troublesome than the case of a weight raised and hung on a hook. Something—some opposition force—sustains the weight, *i.e.* opposes the pull of the earth, and it matters little whether the opponent be a shelf beneath it or the moon above it. The important thing to understand is the nature of the downward propelling force—indeed, of both the upward and the downward force—in either case.

The question whether the energy of a raised weight is potential or kinetic is of little or no importance. The energy is certainly potential, according to our definition of potential. So is the energy of a strained spring: for there also the atoms are separated against their mutual (cohesive) attraction, and there again the energy really resides in the æther. But that all energy may turn out to be ultimately kinetic—when we come to understand what elastic stress fundamentally is—that proposition is not negatived in the least.

Mr. Brush proposes a shadow theory of gravitation, a modification of Le Sage's theory except that the pressure is supposed due to the non-syntonic impact of waves travelling in all directions, instead of to a bombardment of utterly minute particles flying at random. There is nothing new in a shadow theory, and all such theories are faced with the difficulty of plausibly explaining the absence of noticeable screening—a difficulty which is bound to reduce them to acquiescence in an approximation.

The contribution which Mr. Brush makes to the discussion is the suggestion that the supposed gravitational æther-waves are the result of accumulated thermal radiation from all past and present suns, the wave-lengths having automatically increased during their long storage.

To this view several objections might be urged—one of them being that in that case the constant of gravitation would be secularly increasing; another, that it should be greater in a hot enclosure, say the interior of a sun, than elsewhere; but a more salient obstacle is raised by the inquiry as to which is cause and which is effect. How did the bodies get hot and so radiate? Was not their heat perhaps due to their having clashed together with gravitational energy itself derived from the æther?

The fact is that every question concerning *origin* involves us always in insuperable puzzles, and that is just the main difficulty about gravitation. An atom of matter, by its very existence, sets up a fixed stress in the æther, varying directly as the mass and inversely as the distance—that is only another way of stating the law of gravitation; we are trying to understand the nature and cause of that stress. It appears to be one of the fundamental properties of matter, and until we can understand what is meant by the generation or destruction of an atom—*i.e.* of an electron if that is the fundamental unit—we are hardly likely to understand its gravitational influence more than any other of its fundamental properties—including, perhaps, existence itself.

Let this not be understood as a negative prediction or estimate of impossibility—such predictions are always absurd; it may be that when the structure of an electron

is understood, we shall see that an "even-powered" stress in the surrounding æther is necessarily involved. What I do feel instinctively is that *this* is the direction for discovery, that what is needed is something internal and intrinsic, and that all attempts to explain gravitation as due to the action of some external agency, whether flying particles or impinging waves, are doomed to failure; for all these speculations regard the atom as a foreign substance—a sort of "grit" in the æther—driven hither and thither by forces alien to itself. When, some day, we understand the real relation between matter and æther, I venture to predict that we shall perceive something more satisfying than that. Oliver Lodge.

University of Birmingham, March 25.

Visual Sensations from the Alternating Magnetic Field.

There is no necessity to look to suggestion or other abstruse causes to account for this phenomenon. The electric currents induced in the head are quite sufficient to produce the effect.

As I pointed out in a letter to *The Electrician* on April 22, 1910, electrodeless currents in the body produced by electromagnetic induction from a coil carrying so-called high-frequency currents have been in use in medical practice for some years.

Employing as primary a coil of wire of many turns, and some 2 feet in diameter, carrying high-frequency currents from the discharges of a large battery of Leyden jars, and using as secondary the body and the two arms bent so as to form a circle, sufficient current can be induced in the circuit formed by the arms and body to light a miniature incandescent lamp connected between the two hands, or a sufficient difference of potential can be produced between the two hands to cause small sparks to pass visibly between them when they are held near together.

It is easy to produce the visual flickering effect by passing through the head the current from an ordinary continuous-current magneto generator, such as is supplied with the Evershed ohm-meter. One terminal of the generator should be held in one hand, while a wire from the other terminal should be held in the other hand in contact with a small piece of wet sponge, and the latter pressed lightly on one side of the head just behind the eye. If the generator handle is then slowly turned (and it is wise to turn it slowly to avoid unpleasant results) the flickering effect will at once become very noticeable, and as the frequency of the flicker increases with the speed of revolution, it apparently is connected with pulsations in the current due to the slow revolutions and the few segments on the commutator. The current through the head must be very small, as the bulk of that generated goes from hand to hand through the arms and body.

I first noticed this phenomenon some fifteen years ago when treating myself electrically for neuralgia, but I fancy that the effects of electric currents on vision have been known much longer than that.

Passing electric currents through the head in certain directions also produces a metallic taste in the mouth.

A. A. Campbell Swinton.

66 Victoria Street, Westminster, March 24.

The Angular Speed of Rotation of a Long-enduring Prominence.

Thanks to the note contained in the "Astronomical Column" of Nature of March 9, my attention has been directed to the very interesting article under the above heading in the January issue of the *Astrophysical Journal*.

The prominence Mr. Evershed describes is the same as that under consideration in my letter contained in Nature of February 23, and of which disc-spectroheliograms were given in the issue of February 2 in connection with the reproduction of M. Deslandres' address of June 12, 1910. The Meudon spectroheliograms add thus a plate to the series enumerated by Mr. Evershed on p. 3 (*Astrophysical Journal*, No. 1, vol. xxxiii.), and an additional date is further added by the spectroheliogram taken at Meudon on April 15, 1910. Both are beautifully reproduced in the fine memoir forming vol. iv. of the *Annales* of the Obs. d'Astr. Physique de Paris, of which M. Deslandres is the author.

The Meudon spectroheliograms seem greatly superior to those accompanying Mr. Evershed's article in the *Astrophysical Journal*, undoubtedly on account of the excellent and original instrumental combination resorted to by M. Deslandres, which aims at *the absolute isolation of the central rays* K_3 *of calcium or of* $H\alpha$ *of hydrogen*. Comparing the Meudon spectroheliogram of March 21 with what Mr. Evershed says (p. 5) as regards the appearance of the dark formation under discussion, one cannot help being struck by the seeming divergence of the evidence. Mr. Evershed says:—"On March 21 it reappears as a *vague* and *ill-defined* dark mass." Further, he states on March 25 that "the northern arm can indeed be faintly traced for a much greater distance in a vast circular sweep towards the eastern limb." Reverting, now, to the Meudon spectroheliogram of March 21, the dark mass is seen of quite immense breadth longitudinally, no fewer than 5 degrees, is pronouncedly distinct in its entire vast extent also latitudinally, shows well-defined western and eastern contours, both convex towards the west, and also shows the narrow extension towards the N.N.E. quite distinctly. This great difference of what the Kodaikánal plate for March 21 shows as compared with the plate taken on the same day at Meudon, creates in my mind a doubt as to the actuality of what Mr. Evershed suggests on p. 6, viz. the disappearance in its entirety of the dark formation between March 25 and 26.

With due deference to the able observer, I venture to say that possibly inaccurate relative setting of first and second slits, along with insufficient dispersive power or other optical inferiority to the Meudon spectroheliograph, has not allowed the Kodaikánal plates to be so sharp and rich in detail as the Meudon plates. This is further suggested by the striking absence on the Kodaikánal plates of many conspicuous dark calcium flocculi, which during those days infested the sun's disc all over, yet, of course, there is the possibility of their temporary absence; but, on the other hand, on each of the successive appearances of the large prominence on the east or west limbs, the formation exhibited the striking feature of a dark, flat cloud hovering over the bright prominence-range along its entire latitudinal extent, as described in my letter, suggesting, therefore, continuity rather than intermittent or "puffing" action. The Meudon plate taken on April 15 clearly shows the re-entry into the disc of the dark formation, with a more acute apex directed towards the west than during the previous transit, and the N.N.E. directed arm is not yet absent as it is on the Kodaikánal plate of April 18.

Incidentally, another exceptional feature of the sun's disc should be mentioned which was strikingly on view during April and May, 1910, viz. the fine circumpolar wreath of dark flocculi in the south. A formation of this kind goes a long way towards explaining the previously puzzling experience of observing for many days in succession prominences at apparently the same position-angles in comparatively low latitudes. These prominences are, as a rule, of the quiescent, brushy, and rather dull type. Albert Alfred Buss.

"Barrowdale," 22 Egerton Road, Chorlton-cum-Hardy, Manchester, March 19.

The Flow of Thin Liquid Films.

In the very interesting letter by Mr. W. G. Royal-Dawson in Nature of March 23 on the above subject, the peculiar character of the stream-lines round a moving air bubble compared with those round a fixed solid obstacle may seem to some to require an explanation. As the writer of the letter offers none, may I be permitted to state what appears to be the cause of the conflicting currents shown in Fig. 4 of Mr. Royal-Dawson's letter?

It is stated that on pressing the cover-glass the bubble seems to increase in size. From this we may conclude that it is in contact with the glass surfaces top and bottom. It will therefore be more or less anchored. The result of this is that if it is to move it can only do so by the formation of new film on the front, or by the old film which is collecting in the rear from the top and bottom of the bubble moving to the front. As water offers

resistance to the formation of new film, the film-tension in the front will be greater than in the rear, and the film will be dragged from the rear to the front of the bubble, and in its movement will carry the water in contact with it, thus causing the forward current *a*. As the supply of film has to travel in a narrow stream in the middle of the space between the two glasses, it will flow with considerable velocity, as it has to provide film for all the area dragged on by contact with the glass surfaces.

John Aitken.

Ardenlea, Falkirk, N.B.

Insect Intelligence.

My friend Prof. Hughes's story about a fox's cleverness in getting rid of his fleas induces me to recount an instance of insect intelligence which I witnessed about fifty years ago at Elmstead in Essex, a place teeming with insect life. There was a narrow border round the wall of my house; on this I noticed one day a large fly of the ichneumon family straddling over and dragging a green caterpillar bigger than itself. I watched it crawling for some thirty or more yards round an angle of the house until it came to a corner protected by a projection of the wall. Here it deposited the caterpillar, and removed one by one a little heap of small stones. This disclosed a cylindrical hole in the ground, into which the fly descended tail first, dragging the caterpillar after it. It then came out, and again went down, apparently stamping the caterpillar close, and may probably at the same time have laid an egg. It then came up, replaced the stones so as to hide the orifice, and flew away.

This probably was only an instance of the mode of proceeding of the whole species, but notice what it involves. The insect must have dug the deep hole and hidden the entrance to it carefully for future use, and it must have remembered its position so as to find it again from whatever quarter where it may have chanced to find its prey.

Graveley, Huntingdon. Osmond Fisher.

Reflection of Ultra-violet Rays by Snow.

Allow me to make the following short statement in the columns of Nature.

During the past winter we have had frequent snowfalls here in Switzerland, these being followed very often by bright sunshine. I availed myself of these occasions to determine to what extent the spectra of sunlight, reflected by snowfields, reaches into the ultra-violet. To this end I took numerous photographs of the spectrum produced by this reflected light, the angle being 45°. The time of exposure varied from 1 second to 20 seconds, with a slit opening of 0·05 mm. The results showed that this spectrum of reflected sunlight reaches up to 295 $\mu\mu$. The tests were made between 10 and 12 o'clock a.m. at an altitude of 630 metres above the sea-level.

Comparing the results with those of Cornu, we must conclude that the ultra-violet rays are reflected by snowfields almost in their entirety, and hence the powerful action of this light cannot be called into question. It would therefore be advisable at all times, during a period of snow and sunshine, to protect the eyes from the injurious effects of these ultra-violet rays by using glasses which will not permit these rays to pass.

J. v. Kowalski.

Université de Fribourg, Institut de Physique, March 20.

Assil Cotton.

A form of cotton has been produced, by selection in the field from superior growths of Mit Afifi, which is said to be a pure strain and similar to the Mit Afifi of twenty years ago. This form is known by the name of "Assil," meaning "of pure original strain."

In order to prevent any misconception occurring that by substituting "Assil" for the present impure Mit Afifi the introduction of a new variety is advocated, it is recommended that this form of cotton be for the present referred to as "Assil Afifi."

G. C. Dudgeon.
(*Director-General.*)

Department of Agriculture, Cairo, March 21.

INSURANCE AGAINST RAIN.

A scheme of holiday insurance against rain has been put forward by the Excess Insurance Company, and has been described in considerable detail in *The Times* of March 21 and 22. It applies to the period from May 1 to September 30, at a series of sixty-three sea-coast towns on the south and east of England. It is stated that the daily readings of rain gauges at the towns in question (or in some cases where there is no local observer at a neighbouring town), will be supplied to the company by the town clerks, or "culled from the lists of the Meteorological Office." Four forms of policy are proposed, designated respectively Pluvius A, B, C, and D. Policy A provides for payment for each separate week in which there is rain on more than two days, amounting on each to more than 0·20 in., and the premium is to be one-eighth of the compensation to be paid per week. Policy B provides for payment for every day on which the rainfall exceeds 0·20 in., and the weekly premium is equal to one and a half times the compensation offered per day. Policy C provides for payment for the second and each additional rain-day in a week on which the rainfall exceeds 0·15 in., and the weekly premium is equal to the daily compensation, and Policy D provides for four days, payment being made for every day on which more than 0·20 in. falls, and the premium for the four days is equal to the compensation per day.

The interest of the proposition lies in the fact that the rain for which compensation is to be paid may fall entirely at night and not affect the enjoyment of the holiday at all, and as much compensation will be paid, so far as we can judge, for a thunder-shower of ten minutes' duration yielding just more than 0·20 in. as for a day of uninterrupted rain for twenty-four hours, yielding two or three inches. As there is no necessity laid on the assured to prove damage or even to go near the place where the rain is to be measured, it is apparent that a question may arise as to whether the transaction in certain cases is legitimate insurance or mere gambling. The assured and the company are bound by the terms of the policy to accept the readings of daily rainfall supplied from a specified rain gauge as binding, but no information is given in the articles from which we quote as to the limits of the rainfall day, *e.g.* whether it is to count from 9 a.m. to 9 a.m., as in ordinary records, or from 7 a.m. to 7 a.m., as at the daily reporting stations of the Meteorological Office. No indication is given as to how the records from those stations which read rainfall to three places of decimals are to be interpreted; for instance, one observer records 0·204, where another for the same quantity in the measuring glass records 0·20; the first records 0·206 where the other records 0·21; and when the first records 0·205 the second may read 0·20 or 0·21 with equal truth; but the alternative he chooses would decide the payment or non-payment of perhaps a considerable sum as compensation.

It must also be remembered, as Dr. H. R. Mill points out in *The Times* of March 23, that in summer the rainfall varies very greatly in a short distance, and unless the assured stays very near the rain gauge he may experience totally different weather from that which it records. Here, however, the chance is even of the rainfall being more or less than is recorded—in the one case he may be damaged without compensation, in the other he may be compensated without damage. Dr. Mill considers that there are no data yet elaborated on which a fair basis for an equitable and practicable scheme of insurances against rain risks can be framed.

THE LAND OF THE HITTITES.[1]

PROF. GARSTANG has written an able and informing book on recent archæological exploration and discoveries in Asia Minor. The book is written *à propos* of Prof. Garstang's recent discovery of a Hittite palace at Sakjegeuzi (Sakčegözü), in North Syria, south of the Taurus, near the palace-fortress of Sinjirli, excavated by the Germans some years ago. Prof. Garstang has also visited Boghaz Köi, the site of Khatti, the ancient Hittite capital (lately excavated by Dr. Winckler and Makridi Bey), and other Hittite sites and monuments. The result is the present work, which sums up all that is known on the subjects of the Hittites up to date.

FIG. 1.—Sakje-Geuzi: Royal Hunting Scène. From "The Land of the Hittites."

Naturally, much that Prof. Garstang says about the Hittite monuments is mere repetition of what has already been said by others, except in cases where he is able to add the results of his own personal investigations. And the initial "Chapter on Geography" is perhaps rather tedious. The valuable part of the work consists of chapters iv. and v., the descriptions of Boghaz Köi, Eyuk, Sinjirli, and Sakjegeuzi. Chapter vi. should, we think, have been combined with chapter iii., to form a continuous history of the Anatolian civilisation. The greater part of chapter vi., "the story of the Hittites," is based upon the Babylonian cuneiform tablets discovered by Winckler at Boghaz Köi, which have thrown so unexpected a light on the history of the Hittite kingdom from the time of Shubbiluliuma, the contemporary of the Egyptian Amenhetep III., to that of Arnuanta, who was a contemporary of Meneptah, a period of two centuries (1400–1200 B.C.). The story, as told by Prof. Garstang, is worth reading by those who are not acquainted with Dr. Winckler's original publication in the *Mitteilungen* of the German Orient Society. The tale of Shubbiluliuma's wars and the intrigues which gained his purposes even more effectually than his wars sounds like a bit of mediæval Italian history. He was at the bottom of the revolt which separated Palestine from Egypt when it was seen that the pacifist fanatic Akhenaten would never use force to keep his empire. Shubbiluliuma was a most unphilosophical person; Akhenaten was, we suppose, a philosopher; he had lovely ideas. The philosopher's reign caused unheard-of misery to descend upon his unhappy country, as usual, while the unphilosophical man of action got all he wanted, and, being armed, kept his own goods in peace. *Verb. sap.*

However, they were not always strong men in Khatti, and Arnuanta was probably the last of his race. Overthrown by a great folk-wandering from Europe, his kingdom was destroyed, and as a great empire disappears from history. The small States into which it broke up preserved their Hittite characteristics for some centuries later. The palaces of Sinjirli and Sakjegeuzi belong to this later period, and Assyrian influence is seen to be strong in their art. The buildings of Boghaz Köi and Eyuk, on the contrary, certainly belong to the great period of the kingdom, though they may not, as they stand, be as old as the time of Shubbiluliuma. In their art there is no trace whatever of Assyrian influence. Prof. Garstang's account of them, and of the results of the recent diggings, is very interesting.

The photographs with which the book is illustrated are very good, but are not always exactly appropriate. This is a pity. Prof. Garstang still hankers after exploded "Mongoloid" origins for the Hittites, and even prints photographs of Egyptian representations of them to prove his point (p. 318), which do not prove it at all; while to quote pigtails as a Mongolian trait is unscientific: Frederick the Great and George III. wore pigtails, but were not Mongols. Also, one cannot see anything "Proto-Greek" in the types shown in the companion photograph opposite the same page. What is "Proto-Greek"?

FIG. 2.—Dimerli: a fallen Lion. From "The Land of the Hittites."

Prof. Sayce's introduction is interesting in view of the fact that he and the late Dr. Wright were the pioneers of archæological theory in this field, based on Perrot's admirable description of the monuments. Prof. Sayce is now engaged on the congenial task of deciphering the Hittite hieroglyphics. Prof. Garstang tentatively accepts some of Prof. Sayce's inter-

[1] "The Land of the Hittites: an Account of Recent Explorations and Discoveries in Asia Minor, with Descriptions of the Hittite Monuments." By Prof. John Garstang. Pp. xxiv+415. (London: Constable and Co., 1910.) Price 12s. 9d. net.

pretations, but the historians mostly seem to prefer to wait yet awhile before adopting his system definitely.

We hope that Prof. Garstang will make further discoveries in the Hittite lands, and can wish him no better luck than that he may speedily render his present book obsolete and out of date. H. H.

MELANESIANS AND POLYNESIANS.[1]

THE veteran missionary who writes this book lived for more than twenty years on the islands of the Pacific, at the time—a generation ago—when the peoples of the western Pacific were scarcely known, when

> ". . . Old and New
> Weltered upon the border of the world."

Much of his time was spent in New Britain, more in Samoa, and the natives of these places are the people whom he means when he speaks of Melanesians and Polynesians. Dr. Brown has also visited the New Hebrides, Santa Cruz, New Ireland, New Hanover, New Guinea, and the atolls of Ontong, Java, and the Tasman group. In the introduction the author disclaims "pet theories"; nevertheless he gives us (pp. 15–17) the theory as to the origin of the Melanesian and Polynesian races, which he published in the *Journal* of the Anthropological Institute in 1887. Much water has flowed under the bridges since then, and it is at least a pity that Dr. Brown does not discuss (except briefly in the concluding chapter) some of the facts which do not support his views.

A certain looseness of terminology, most pronounced in the pages referred to, also crops up in other parts of the book. Considering especially the most valuable part of the book, that dealing with Melanesia, it is obvious that Dr. Brown has given us a record of what he himself saw or was told during the five years he spent in New Britain, but with the exception to be presently noted he has made no attempt to correlate his own observations with those of other observers, nor does he supplement them by considering the work of others, even when they deal with the very ceremonies he describes. Thus it comes about that the value of one of the most interesting chapters in the book, that dealing with secret societies, is lessened, for though it gives an account of the Dukduk, no mention is made of Parkinson's work. On the other hand, Dr. Brown has not hesitated to avail himself of information given him by colleagues, or when necessary to seek their assistance. These remarks indicate the scope of the work and its limitations, which will be felt by few except specialists working at the history of the Pacific.

Fish Trap, New Britain. From "Melanesians and Polynesians."

A more detailed examination of the contents of the volume shows that it contains a large amount of new information, not only valuable in itself, but bearing also on work being done at the present time, or which must be done in the near future. There is an extremely interesting account by an eye-witness of the death and cremation of the celebrated Shortland chief Gorai, whose importance may be gauged by the fact recorded by Guppy, that the houses of his wives and children occupied more than an acre of ground.

Several interesting examples of the widely-spread Melanesian custom of burial, accompanied by the removal and preservation of the skull of the deceased, are recorded. On Duke of York Island the body of a chief or person of importance was exposed on a specially built platform until the head could be detached, when it was preserved by the

[1] "Melanesians and Polynesians," their Life-histories described and compared. By George Brown. Pp. xv+451. (London: Macmillan and Co., Ltd., 1910). Price 12s. net.

nearest relative, while the remains were buried in the house. On Ysabel (Solomon Islands) and also in Aneityum (New Hebrides) the body was buried in such a position that the head could be severed from the trunk, which was not itself exposed. At Ysabel the process was accelerated by lighting fires round the exposed head, from which the scorched flesh was easily peeled. At Aneityum female mourners watched the head until the soft tissues had decomposed. A special interest attaches to both these methods, since they contrast with the disposal of the dead by cremation practised in some of the western Solomons and New Ireland, while they agree in principle and in some degree in detail, with the methods of inhumation accompanied by the preservation of the skulls in vogue among the archipelagoes lying off the eastern extremity of New Guinea. These facts support a view held by the reviewer that the inhabitants of the Solomon Islands will be found to be divisible into two ethnic groups, the dividing line falling somewhere in the neighbourhood of the line of political division.

Dr. Brown mentions that on his early journeys in New Britain he was able to buy fowls of a small white breed in large numbers, and he suggests that these were indigenous. The interest of this observation is greatly increased by the fact that in many parts of eastern British New Guinea the natives maintain that thirty or forty years ago they possessed a breed of pure white fowls.

No praise could be too high for the plates with which this book is abundantly illustrated. One picture shows four men of the remote islet Lua Niua (Ontong Java), who speak a language "very closely related to the Samoan." So far as the writer knows this is the first adequate portrait to be published of these Polynesians, stranded long ago in Melanesia, who although they have retained their Polynesian features appear to have come into intimate contact with Melanesians since, as Dr. Brown informs us, they are divided into two exogamous classes. An alternate explanation favoured by Dr. Brown is that they are descended from a group of exogamous castaways from the Ellice group, who, it is assumed, were derived from Samoa at a time when that island was inhabited by a people having an exogamous clan organisation.

Two unfortunate slips occur in the description of the plates. The masks and figures shown in the upper figure facing p. 238 are from New Ireland (not from New Guinea), and the two masks facing p. 316, also attributed to New Guinea, certainly do not come from there. An insufficient index gives an inadequate idea of the real value of the book. C. G. S.

THE BUSINESS SIDE OF A UNIVERSITY.[1]

UP to the present time the development of the American university system has proceeded mainly by the multiplication of universities, and by increase in their endowments. The cost of university education has, however, steadily risen everywhere; and while it has been possible up till now to provide for expansion by increased contributions of funds from outside, it is clear that a limit exists to the possibilities of further increase. It follows that the question as to whether the efficiency of American universities can be increased by a better use of their existing resources is an important question which may become urgent in the future, even if it has not done so in the past.

Under the auspices of the Carnegie Foundation for the Advancement of Teaching, a report has been drawn up on "Academic and Industrial Efficiency." The author, Mr. Morris Llewellyn Cooke, claims to have studied the problem practically exclusively from the point of view of a business man, while freely admitting that there are other aspects of the question not dealt with in his report. In order to collect information, he visited eight universities and colleges, and in every case chose the department of physics for his inquiries, on the ground that the conditions prevailing in this department might be regarded as typical of those prevailing generally in the work of all departments. He notices a certain lack of intensiveness in the work of the colleges, and while admitting that a considerable amount of leisure is wanted for the teaching staff and those engaged in private research, points out that this affords no reason why janitors and gardeners should not carry on their duties out of lecture hours.

On the difficult question of administration, Mr. Cooke expresses fairly definite views. Three methods of administration are possible: firstly, "committee management"; secondly, what he calls the "military type," in which the whole of the direction falls on the shoulders of one man; and thirdly, what Mr. Cooke describes as "functional" management, in which the responsibility is divided amongst a number of individuals, each having complete authority over a limited range of duties. Observing that the system of government by committees does not prevail in the business world, the author objects to this system on the ground that it tends to produce lack of initiative, departmental autonomy, and lack of authority on the part of the heads of departments, especially in the matter of discipline when their decisions are liable to revision at the hands of a board or committee. The functional system is considered to be the best, though the author admits that the other systems are in many cases working well, and better than he would have expected.

Under the heading, "The College Teacher as a Producer," Mr. Cooke refers to the difficulty of increasing the efficiency of professors so long as their duties are so multifarious and varied as they are at present. He is quite astonished at the number of tasks they have to perform. Teaching, research, and administration alone form a group of duties, of which it is difficult for the same individual to combine more than two efficiently. But, in addition, it is becoming increasingly important for the professor to keep himself in touch with what is being done elsewhere, and this involves study of pedagogic methods as well as of the literature of his own subject. Moreover, the committee system, where it exists, makes increasing demands on his time. Yet Mr. Cooke finds professors spending time in taking inventories, keeping track of appropriations, mimeographing examination papers, and handling routine correspondence. "These things," he points out, "are clerical work, and should be handled outside of the teaching field, and not as a part of the teacher's duties." Further on he observes: "The high-priced presidents of our railways, banks, and steel companies would not dream of performing this variety of functions. They would refuse to do so, because they know they could not do them well. This part of raising the efficiency of the college professor will have to be done by building up central agencies for doing much of the work he does now, and for doing it so much better than he possibly can, that he will be glad to relinquish his responsibilities in these respects."

Passing on to the question of "research," the author directs attention to the danger which exists of sacrificing efficiency in other directions, especially in class-teaching, by attaching exaggerated importance to work of a research character. Mr. Cooke is here

[1] "Academic and Industrial Efficiency." A Report to the Carnegie Foundation for the Advancement of Teaching. By M. L. Cooke. Pp. vii+134. (New York City, 1910.)

opening up a question which it will be difficult to discuss adequately without raising controversies of a somewhat heated character, and it is clear that unless the subject be approached with the greatest caution by unprejudiced individuals, an inquiry may do harm instead of doing good. On one aspect of the question little difference of opinion will probably exist. Mr. Cooke directs attention to the case of a professor who felt that his ability lay in the direction of teaching, but who was more or less forced to undertake research owing to pressure from his colleagues. Another authority informed him that it was becoming increasingly difficult to discover profitable lines of research. To those whose main difficulty is to know what can be left uninvestigated and unpublished with the least sacrifice, these remarks must come as a surprise. They may suggest that facilities for research are not bringing relief in the quarters where it is most needed, and that there is something in Mr. Cooke's opinion that research ought to be subject to some kind of control or inspection. But would not such a system, if carried out under existing and not under ideal conditions, have the exactly opposite effect to that which Mr. Cooke desires? The difficulty is that nobody who is not engaged on a piece of original work or research can appreciate its significance and difficulty, and any attempt to assess such work from without would tend to the adoption of a standard of quantity rather than of quality; a premium would be placed on those investigations which were of the most superficial character. In this connection no analogy probably exists in business matters.

Tables are given showing, still for the department of physics, the relative cost and direct expense attributable to research and teaching. For the eight institutions under investigation, research absorbs on the average about one-third of the whole, but the author admits that physics is exceptional. Coming next to the question of economical use of buildings, attention is directed to the small number of hours in which each lecture-room is generally in use, and in this connection the earmarking of lecture-rooms for the exclusive use of one department is deprecated.

The next part of the report deals mainly with proposals for reorganising the administrative side of a college and for better control of its finances. Under the heading of "Functional Activities," the author suggests the establishment or reorganisation of the offices described under the following heads: Superintendent of grounds and buildings; interdepartmental janitor service; purchasing department; stores department; mail handling by a central office; bursar's department; disciplinarian; bureau of publicity; registrar; and bureau of inspection. Under the last heading it is suggested that perhaps the examination system may be found to exercise a useful function, and Mr. Cooke advocates the reintroduction of external examiners for the purpose. Under "Financial Administration" he advocates closer relations between the expenditure on different departments and their corresponding output of work. In a section headed "Physics Departmental Administration" he directs attention to the frequent expenditure of large sums on the purchase of apparatus which are only used for a limited period, and suggests that means should be devised whereby apparatus which have ceased to be useful in one particular college might be made available elsewhere. Under "Student Administration" he instances a few cases of slackness in respect of attendance; this is, of course, a matter that can be easily remedied from within. The rest of the report consists mainly of tables.

The author found everywhere the greatest willingness to cooperate with him in his inquiry, coupled by a keen desire to profit by any suggestions to which that inquiry might lead. No higher praise from a business man to a college professor could be given than his statement: "It would probably be impossible to find a group of men more willing to let one know the full measure of their ideals and of the work done than are the men of the universities." It is clear that if, and so far as, the American universities admit of reforms on the lines suggested, such reforms can and doubtless will be effected from within.

In an English review one is naturally somewhat concerned with the possible effects of Mr. Cooke's report on our own university system, and one cannot but feel a certain apprehension lest such a report falling into the hands of an outsider might be used as a tool for attempting to effect changes from without in a way which certainly would involve a very far-reaching temporary, if not permanent, waste of efficiency.

Now in most of our modern universities and colleges the supreme authority is vested in a council or board of governors consisting mainly of business men, and such a board possesses all the powers of inspection which Mr. Cooke desires to obtain in America. It also, in general, possesses the right of appointing and dismissing any member of the teaching staff, and the safeguards for securing that a professor shall only hold office as long as he continues to prove an efficient teacher are provided for to an extent which probably represents more than Mr. Cooke would consider desirable in his country. The teachers are often called on to furnish such boards with statements as to the progress of work in their departments, and may be called upon to reply to inquiries. In colleges receiving Treasury grants, further inspection on behalf of the Government is also contemplated, and detailed reports have to be furnished as to the work of the colleges and their departments. These reports include statements regarding research and the publication of original work. In regard to the keeping of students' records, different practices necessarily exist in different institutions, but this form of supervision is probably almost universal, and it is certain that in many instances we have got far more than Mr. Cooke would ask for in America.

In regard to the relative expenditure on teaching and research, it is certain that even in a department like physics we cannot furnish figures at all comparing with Mr. Cooke's. A not infrequent experience over here is to find teachers spending a not inconsiderable portion of their small salaries in the purchase of materials for researches conducted in the college laboratories. As regards the apportionment of grants in relation to the work of the departments, we here are usually in the position of having to make a little money go a long way, and the adoption of a standard based on numbers of students has certainly been carried beyond the limit conducive to the greatest efficiency. Last, but not least, there is probably not a college in this country which dispenses with the external examiner or the external examination.

The general conclusion is that the direction in which Mr. Cooke suggests reform tends rather towards assimilating the American university system to the system of most recent development in Great Britain. At the same time it does not necessarily follow that we ought to relax our efforts to move towards the existing American ideal. It may easily happen that the conditions for maximum efficiency are satisfied by some system which is intermediate between the two. While these remarks apply more particularly to such questions as inspection and relative importance of research, it cannot be denied that in the matter of general organisation much the same diversity prevails as Mr. Cooke finds in the United States. At

one centre the committee system is brought to bear on the most trivial details of domestic management; in another case a central authority practically decides even such matters as forfeiture of scholarships in cases of discipline. It may be that these divergences are the result of varying local conditions, but a study of them might well be extended to our universities.

Since the preceding notice was written, we have received a criticism of Mr. Cooke's report by President R. C. Maclaurin, of the Massachussets Institute of Technology, published in *Science*, xxxiii., 838, pp. 101–103 (January 20). Attention is particularly directed to the fact that most of the points raised in the report are not new. "It is full of commonplaces, and there is scarcely a question raised that has not been discussed *ad nauseam* by college professors and other officers. It is not lacking in confidence. One marvels at the temerity even of an 'efficiency engineer' who can lay down the law so definitely as to how to teach physics, how to conduct a recitation, how to carry on research, when most of us who have devoted our whole lives to such problems are far less confident." President Maclaurin specially condemns the "student-hour" standard of efficiency and the proposal for inspection of research, the futility of which has been pointed out above, and he instances his point by the following imaginary dialogue between Newton and the "superintendent of buildings and grounds, or other competent authority."

"*Superintendent:* Your theory of gravitation is hanging fire unduly. The director insists on a finished report, filed in his office, by 9 a.m. Monday next, typewritten, and the main points underlined. Also a careful estimate of the cost of the research per student-hour.

"*Newton:* But there is one difficulty that has been puzzling me for fourteen years, and I am not quite . . .

"*Superintendent* (with snap and vigour): Guess you had better overcome that difficulty by Monday morning or quit."

G. H. BRYAN.

THE MOTIONS OF THE PLANETS JUPITER AND SATURN.

THE January number of the *South African Journal of Science* contains an excellent paper by Mr. R. T. A. Innes on Le Verrier's theory of the motion of the planets Jupiter and Saturn. The title scarcely covers all that is in the paper, for the author concludes with numerical calculations, based upon formulæ developed by himself in the Monthly Notices for 1909, which must constitute a considerable step towards a revision of Le Verrier's theory.

Mr. Innes's chief criticism on Le Verrier is that he has taken 9·7367408 instead of 9·7365514 for the log ratio of the mean distances of Jupiter and Saturn, an error approximately of one part in two thousand.

The error is, however, considerably magnified when its effects upon the series representing the reciprocal of the distance between Jupiter and Saturn are considered, and the author's final conclusion is that the fourth significant figure always, and the third often, is incorrect in Le Verrier's perturbations. The error arose because Le Verrier used the mean distances corresponding in elliptic theory with the mean motions and neglected the systematic effects of the perturbations. Jupiter, for instance, on a distant planet like Neptune, may be approximately considered as coalescing with the sun, making that body heavier by one-thousandth part, and consequently the mean distance of Neptune greater by one part in three thousand.

The mean distance of Saturn needs correction by a greater fraction, nearly one part in two thousand; for when Jupiter is between Saturn and the sun, its attraction amounts to about four parts in a thousand of that of the sun, and the average is thus raised.

Le Verrier's omission is unimportant in all other cases. For the four inner planets the perturbations are so small that the third significant figure is insensible, and for Neptune and Uranus the increment due to Jupiter is practically the same and the ratio inappreciably altered.

We quote, for ready reference, a most valuable table:—

Planet	Log mean distance	
	Elliptic theory	Actual
Mercury	9·5878 2168	9·5878 2160
Venus	9·8593 3781	9·8593 3745
Earth	0·0000 0001	0·0000 0012
Mars	0·1828 9703	0·1828 9616
Jupiter	0·7162 3747	0·7162 3339
Saturn	0·9794 9655	0·9796 7915
Uranus	1·2829 0024	1·2830 9713
Neptune	1·4779 4661	1·4781 4316

Some *obiter dicta* in the paper are of great interest. Here is one:—

"So far as merely obtaining an ephemeris goes, it is probable that the method of special perturbations would have given one for 300 years or so with less labour than was involved in either the theories of Hill or Le Verrier."

This sets one thinking why we want the theories. Of course, we want the general results of theory, the first and foremost being that the mean distances are subject to no secular changes. And we want the outline of the theory of long-period inequalities with rough estimates of the numerical coefficients. But an ephemeris of Neptune could be obtained by special perturbations at 512-day intervals (using a power of 2); fifty intervals of 512 days each would cover the period from its discovery to the present day—a month's work.

It is beginning to be recognised that the "theory, good for ages, in which *t* alone has to be substituted," is incomplete. Le Verrier gave some results for the earth 100,000 years ago, based on his theory. If similar theories existed for the minor planets, we doubt, if we should see Eros falling within the orbit of Mars, the Trojan group being captured by Jupiter, and the zone corresponding to a mean motion double that of Jupiter being cleared of small planets. Possibly these phenomena are due to the secular effects of small causes not at present taken into account. We want, therefore, in the cheapest possible way, to multiply accurate ephemerides for comparison with observation.

THE ANTON DOHRN MEMORIAL FUND.

THE zoological station at Naples occupies a unique position among the biological institutions of the world. It is not only the oldest, the largest, and the best equipped of the biological stations, but it has maintained throughout its existence its thoroughly international character. The founder of this important institution, Dr. Anton Dohrn, died on September 26, 1909, and at the eighth International Zoological Congress, held at Graz during August, 1910, it was decided to raise a fund for an international memorial to commemorate his great achievement.

In case some doubt may be entertained as to the maintenance of the international character of the institution which is now under the management of Prof. Reinhard Dohrn, one of the sons of the distinguished founder, it may be remarked that Prof. von

Graff, the president of the congress, has ascertained that no guarantee has been given for the maintenance of the station by any Government or academy, and that, by the terms of an agreement with the city of Naples, no special rights can be obtained in it by any such body during the period of agreement. Prof. Reinhard Dohrn has assumed the entire responsibility of continuing the work of the station, with the provision that, in the event of his death, the responsibility shall pass to another member of the Dohrn family, and subject to the understanding that the station shall remain a completely international institution, in the benefits of which all countries have the right of participating.

The memorial is to take the form of a portrait in bas-relief, to be placed in the zoological station, and of a fund for promoting the efficiency of the station as an international institution for carrying on research in biology.

The amount collected will be reported in 1913 to the ninth International Congress, which will be asked to formulate the conditions under which the fund shall be handed over to the zoological station. The biologists resident in this country who had signified their sympathy with the proposal to establish the memorial fund, and whose names appear in the international list submitted to the Graz meeting, were invited to attend a meeting which was held in the Natural History Museum, Cromwell Road, S.W., on February 3. As a result of this meeting a number of zoologists, representing the principal centres of research in the British Islands, have been asked to form a sub-committee for the British Empire, in order to assist in the work of the international committee, and of this subcommittee Dr. Sidney F. Harmer, F.R.S., was appointed chairman.

Contributions varying in amount from 5*l*. 5*s*. to 10*s*. 6*d*. have already been paid or promised, and it is hoped that the result of the appeal for subscriptions which is being issued will show that Anton Dohrn's great achievement, the establishment and management of the Stazione Zoologica at Naples, is as fully appreciated here as it is in other parts of the world.

Additional subscriptions may be paid to Prof. S. J. Hickson, F.R.S., of the University of Manchester, who is acting as secretary and treasurer of the British subcommittee. Prof. Hickson will be glad to send a copy of the circular which has been issued to any subscriber whose name has been accidentally omitted in drawing up the list of addresses.

NOTES.

WE are asked to state that the annual meeting of the British Science Guild, to be held on Friday, April 7, at the Mansion House, will be opened at 5.0 p.m. instead of 4.0 p.m., as previously announced. The speakers will be:—The Lord Mayor, Viscount Haldane, Sir William White, K.C.B., F.R.S., Sir Albert Spicer, Prof. J. Perry, F.R.S., Dr. R. T. Glazebrook, C.B., F.R.S., Prof. A. D. Waller, F.R.S., and Sir Philip Magnus, M.P.

THE Bakerian lecture of the Royal Society will be delivered by the Hon. R. J. Strutt, F.R.S., on Thursday next, April 6, on the subject of "A Chemically Active Modification of Nitrogen produced by the Electric Discharge." The lecture will be illustrated by experiments.

AT the anniversary meeting of the Royal Irish Academy on March 16 the following were elected honorary members in the section of science:—Hendrik Antoon Lorentz, Berlin; Max Planck, Berlin; Right Hon. Sir Henry Enfield Roscoe, London; and Charles Sprague Sargent, Cambridge, Mass., U.S.A.

THE proposal to establish a museum for London comes at a moment when the subject is better understood than at any other time. Museum work has taken its place in educational requirements, and local history has been shown to be of supreme importance in the development of good citizenship. Of all localities, London is the outstanding city in Britain possessing a history of unique importance. The site of London has been occupied by man since Palæolithic times, through Neolithic times to the historic period when, as a Celtic stronghold, it first became the settlement of a community. As a Roman city, it possesses the finest remains of Roman antiquities in all Britain. Anglo-Saxon, Danish, and later periods are represented by fine series of objects. Remains of beautiful Tudor architecture have been excavated and preserved by the London County Council, which has also preserved and stored every object of interest discovered during its numerous works; the City Corporation has assiduously collected for many years objects discovered in the city, and there are many local collections of considerable interest, both public and private. All this means that there exists already the materials for a London museum from prehistoric to modern times, and it is matter for intense gratification that Mr. Harcourt, when First Commissioner of Works, should have set his hand to this great project and should have carried it through with the aid of a munificent private benefactor. That London should have its own museum of material history as well as its published records is all to the good, though it is late in the day. It is fortunate that the delay in the accomplishment is accompanied by a goodly storehouse of objects awaiting exhibition in a properly organised museum.

LORD CURZON OF KEDLESTON has consented to allow himself to be nominated by the council of the Royal Geographical Society as president of the society in succession to Major Leonard Darwin, who will retire at the anniversary meeting on May 22, after occupying the presidential chair for three years. The annual dinner of the society will be held this year in the Great Hall of the Hotel Cecil on May 26.

A REUTER message from Paris on March 25 states that M. Sommer, the aviator, has made a flight at Mouzon in a biplane with twelve passengers on board, the total weight being 1439 lb.

BY direction of the London County Council, a tablet has been affixed to No. 32 Soho Square (the National Hospital for Diseases of the Heart), where for many years lived Sir Joseph Banks, who for forty-one years—from 1778 to 1820—was president of the Royal Society.

THE meetings of the Institution of Naval Architects will be held at the Royal Society of Arts on April 5–7. In consequence of the death of the late president of the institution, Earl Cawdor, the annual dinner will not be held this year. On April 5 the presentation of the institution premium to Mr. T. B. Abell will be made.

A BRASS tablet to the memory of the late Mr. Cox has been placed in the Hackney Town Hall. The tablet, which was provided by residents in Hackney, bears the words:—"In honour of Harry William Charles Cox, consulting electrician, who died at Hackney July 9, 1910. He contracted a malignant disease while perfecting apparatus for adapting the X-rays to the relief of human suffering."

THE Bessemer gold medal of the Iron and Steel Institute will this year be awarded to Prof. Henri Le Chatelier, the eminent French metallurgist, in recognition of his

great services in the advancement of metallurgical science. The presentation will be made by the Duke of Devonshire, president of the institute, at the annual general meeting to be held in London in May. The Andrew Carnegie gold medal for 1910 will also be awarded at the same meeting, the recipient being M. Felix Robin, Paris.

THE death is announced of Prof. Kekule von Stradonitz, the Berlin archæologist. He was born at Darmstadt in 1839, and took his degree at Berlin in 1861. He then travelled for several years in the Mediterranean, studying Greek and Greco-Roman antiquities. In some monographs on the Theseion in Athens, and on one of the groups in the Villa Ludovisi, he first developed his methods of research. Early in the 'seventies of last century he was appointed to a professorship at Bonn University, and while here he published two important works, one on Tanagra figures and the other on ancient terra-cottas. In 1887 he was appointed director of the sculptures in the Royal Museums, and later to the professorship of classical archæology, and he held both posts until his death.

A PAPER was read before the Society of Antiquaries on March 23 by Messrs. H. E. Balch and D. R. Troup on the exploration of a late Celtic and Romano-British cave-dwelling at Wookey Hole, Somerset. This is close to the Hyæna Den, explored by Prof. Boyd Dawkins fifty years ago. Beneath a small accumulation of surface material was the Roman deposit, containing coins ranging from Vespasian to Valentinian II. Below this, relics of the domestic life of the cave-dwellers were unearthed—a silver earring with the left frontal bone of a girl, and a large series of iron articles. Charred grain and pulse, together with burnt acorns, throw light upon the limited agriculture of the period. The human remains present a problem, and it is practically certain that the persistent occurrence of these along with waste food-bones indicates cannibalism. The excavations are in progress, and will, it may be hoped, throw further light upon these interesting discoveries.

NATURALISTS throughout the world have an opportunity of showing their appreciation of the labours, and regard for the personality, of the late Dr. Anton Dohrn, by contributing to the international memorial fund referred to elsewhere in this issue. It is proposed to place a portrait of Dohrn in bas relief in the Zoological Station which he founded at Naples, and to establish a fund which will ensure the continued efficiency of the station as an international laboratory of biological research. No memorial to Dohrn could have more worthy or appropriate objects, and we hope that naturalists in the British Empire will give a ready and generous response to the subcommittee's appeal for contributions to it. Subscriptions may be sent to Prof. S. J. Hickson, F.R.S., University of Manchester.

THE report of the advisory committee for the Tropical Diseases Research Fund for 1910 has recently been issued, and contains matter of considerable interest. The fund administered in 1910 amounted to 3245*l.*, and is derived from contributions by the Imperial Government, the Government of India, and various Dominion and Colonial Governments, and is expended on grants to the London and Liverpool Schools of Tropical Medicine, and the Universities of London and Cambridge. Reports are included on the work being done and on the manner in which the grants have been expended. Dr. Wenyon records observations on a malady, "Oriental sore," in Bagdad, and some evidence is adduced that the disease is conveyed by a mosquito, a Stegomyia, sp. Dr. Castellani, of Colombo, records cases of bronchitis in Ceylon caused by an Oidium fungus.

THE seventh International Congress against Tuberculosis is to be held in Rome on September 24–30 next. The English section is being organised by the National Association for the Prevention of Consumption and other Forms of Tuberculosis, 20 Hanover Square, W. All the universities and principal towns in the United Kingdom have been invited to send delegates. An executive committee has been formed for the purpose of arousing interest in the congress in this country, and for collecting suitable material in connection with the subject. Dr. J. J. Perkins will act as honorary secretary of this committee. A representative national committee has also been formed, and many distinguished persons have joined it. The congress next September will be divided into three principal sections to deal with the following subjects:—(*a*) etiology and epidemiology of tuberculosis; (*b*) pathology and therapeutics (medical and surgical) of tuberculosis; (*c*) social defence against tuberculosis.

THE sixty-fourth annual meeting of the Palæontographical Society was held in the Geological Society's rooms at Burlington House on March 24, Dr. Henry Woodward, F.R.S., president, in the chair. The annual report referred to the approaching completion of the monographs of Carboniferous Palæoniscid Fishes, English Chalk Fishes, Cretaceous Lamellibranchs, and British Graptolites. The volume for the year included not only instalments of these works, but also a small, complete monograph of British Carboniferous Arachnida, by Mr. R. I. Pocock. Small monographs of special groups of fossils appeared to be acceptable to the members. The Carnegie Trust for the Universities of Scotland had given to the society the plates illustrating the Carboniferous Palæoniscidæ described by Dr. Traquair. Mr. H. Dewey, Mr. Upfield Green, Dr. A. W. Rowe, and Dr. A. Strahan were elected new members of council. Dr. Henry Woodward was re-elected president, and Dr. G. J. Hinde and Dr. A. S. Woodward were re-elected treasurer and secretary respectively.

WE have received a copy of the third edition of the little book on the Brent Valley Bird Sanctuary, by Mr. Wilfred Mark Webb, the chairman of the Sanctuary Committee and honorary secretary of the Selborne Society. It contains a very fully illustrated account of what has been done in an enclosure of nineteen acres which comes into the London postal district, and those who wish to induce the feathered visitors to their gardens to stay and nest as the spring comes on may obtain from it a number of hints. The price of the book is 7*d.* post free (or in paper boards 1*s.* 1*d.*), and it can be obtained from the secretary of the Selborne Society at 42 Bloomsbury Square. The whole of the sixpence or shilling received goes towards the upkeep of the sanctuary.

MR. T. SHEPPARD, curator of the Hull Museum, in his last quarterly report announces the discovery of a series of Neolithic workshops near Bridlington, the scene of the fabrications of the notorious "Flint Jack," which were suggested by the importance of earlier discoveries in this neighbourhood. The material used by these prehistoric craftsmen was chiefly the black flint found in boulders occurring in the glacial clays and gravels ultimately derived from the bed of the North Sea or from its eastern coasts. Mr. Sheppard has now found a vast number of cores, spoilt flakes or "wasters," and flint-knives under the Bridlington cliffs. One worker seems to have made

a speciality of the pink flints, and some specimens resembling the "pygmy" type have been recognised. The finds now announced include oval or pear-shaped scrapers, a second type possibly used for straightening arrow and spear shafts, and a curved implement, which is believed to have been used as a sickle. These implements are now ready for examination by archæologists in the Hull Museum.

In vol. ii., part iii., of Records of the Albany Museum, Mr. J. Hewitt gives a descriptive account of the South African Batrachia, with supplemental notes on the distribution of the various species.

The American Naturalist for March contains two articles on the "genotype" theory of heredity, the one, by Prof. W. Johannsen, dealing with the conception as a whole, while the second, by Prof. E. M. East, treats the hypothesis in connection with hybridisation. After stating that the genotype theory may prove insufficient, or even erroneous, the former author observes that heredity may be defined as the presence of identical genes in ancestors and descendants, or, as Mageen says, in full accordance with this definition:—"The word heredity stands for those properties of the germ-cells that find their expression in the developing and developed organism."

To the *Verhandlungen schweiz. naturfor. Gesellschaft* for 1910 Dr. F. Sarasin contributes a note on the fauna of the Galapagos Islands, in which particular attention is directed to the flightless cormorant, *Nannopterum harrisi*, and the penguin, *Spheniscus mendiculus*; the latter, which is by far the most northern member of its kind, being regarded as a relict of a former extension of the southern ice. The author supports Baur's view as to the continental origin of the Galapagos group, and suggests that its union with the mainland lasted until North and South America were themselves connected by land, but at a period when there was a temporary sundering by means of an arm of the sea, thereby permitting the influx into the Galapagos area of forms from the Carribean coast and the Antilles.

To Mr. J. D. Hamlyn, the well-known animal importer, we are indebted for a copy of a circular containing reference to additional reports in regard to the African "water-elephant." When in French Congo, in 1905, Mr. Hamlyn came across a Panguin hunter who gave an account of a large water-animal inhabiting a lake in the Fernan Faz (Fernand Vaz) district, unvisited by any white man, and not far distant from the coast. It was described as intermediate in size between a hippopotamus and an elephant, with a thick, hairy hide, but no tusks. These animals spend most of their time in the water, and can stay beneath the surface for considerable periods; they are dangerous to approach, and are never hunted by the natives. It may be added that rumours are current of an apparently similar animal inhabiting lakes in northern Rhodesia, and known to Europeans as "water-rhinoceroses," and that in the first edition of the "Encyclopædia of Sport" Colonel F. T. Pollok, in the article Tapir, stated that he had actually seen one or two of these animals below the Congo, and referred to mention of them in 1894 by Captain H. Bailey in "Travel and Adventures in the Congo Free State."

To the *Verhandlungen schweiz. naturfor. Gesellschaft* for 1910, vol. i., Dr. H. Stehlin contributes observations on the evolution and dental development of various ungulates from the lower Tertiary *Bohnerz* of Switzerland. As we proceed from the lower to the higher stages of this formation, a progressive increase in the size of the different species of various groups, accompanied by an increasing dental specialisation, is very noticeable. *Dichodon ruetimeyeri*, for instance, passes, as regards size, through *cartieri* into *subtilis*, with a gradual increase in the length of the crowns of the first three premolars, and the conversion of the fourth of that series from a triangular into a quadricolumnar tooth; and a progression in the matter of general size and the complexity of the fourth upper premolar is observed in species of the genera Lophiotherium and Palæotherium. In the concluding portion of the paper the author points out that there is evidence of free communication between the Old World and North America during the early Eocene, after which there was a sundering of the two continents, while union was once more resumed in the Oligocene. Africa during the Eocene seems to have had no direct communication with Europe, the relationship between the European early Tertiary lemuroids and the modern lemurs of Africa being capable of explanation by means of a land-connection by way of Asia.

The February number of *The Quarterly Journal of Microscopical Science* (vol. lvi., part ii.) consists chiefly of a long memoir, by Prof. F. H. Edgeworth, on the morphology of the cranial muscles in some vertebrates. In this paper Prof. Edgeworth discusses the very difficult and intricate problem of the segmentation of the vertebrate head. He points out that the probable phylogenetic relationships of the various vertebrate groups are determined by the total morphological evidence available, and that the cranial muscles form one item only of such evidence. The interpretation of this evidence is, moreover, rendered very difficult by secondary modifications which have arisen during phylogeny, such as secondary innervation, convergent evolution and degeneration, and in arriving at any conclusion it is necessary to take into account the development as well as the adult structure. The conclusion at which the author actually arrives is that the morphology of the cranial muscles is in favour of an amphibian ancestry of mammals. This result, however, is only reached by considering the sauropsidan features of the cranial muscles as secondary phenomena, and it appears to us that it can hardly be reconciled with the evidence derived from other embryological characters, and, above all, from the geological record.

In describing a collection of Tertiary insects from the lacustrine deposits of British Columbia, in the second volume of Contributions to Canadian Palæontology, Mr. Anton Handlirsch directs attention to the prevalence of certain groups of flies, especially those of the bibionid section, which appear to have formed the chief element in the insect fauna. These are represented exclusively by the genus Penthetria, which at the present day includes, throughout the world, scarcely more species than those in the collection forming the subject of the paper. While the number of fossil Canadian species is estimated at about thirty-five, the existing forms of Penthetria are thirty-six, the allied genus Bibio including ninety-five. "The occurrence of so disproportionately large a number of penthetrias in the Tertiary of British Columbia contemporaneously with the absence of Bibio indicates that the beds in question belong to the early Tertiary, and are at least Oligocene in age. The supposition is obvious that the genus Bibio originated in the East, probably in Europe, and later found its way into North America." It is added that the occurrence of Penthetria and certain other genera indicates that British Columbia enjoyed a warm climate in the Oligocene.

SOME interesting abnormalities in the flowers of Œnothera are recorded by Dr. R. R. Gates in the twentieth report of the Missouri Botanical Garden. The transformation of the sepals into green leaf-like organs, known as virescence or frondescence, and general modification of the floral organs, appeared in several species, notably in *Œnothera multiflora*. Polymery, or an increase in the number of parts, was manifested in certain hybrids of *O. Lamarckiana*; a curious feature was the occurrence of trimerous flowers side by side with a tetramerous and a heptamerous flower. In some cases there were evident signs of coalescence of two flowers, or synanthy.

NATURAL cross-fertilisation among plants in India forms the subject of the latest botanical issue (vol. iii., No. 6) of the Memoirs of the Department of Agriculture in India, compiled by Mr. and Mrs. A. Howard and Mr. A. Rahman Khan. It is noted that natural crossing among wheat plants, which is very rare in England, but is somewhat more frequent in the drier climates of Europe and North America, becomes more common under the much drier conditions prevailing at Lyallpur. The conclusion follows that wheat breeding in the canal colonies of the Punjab will necessitate the exercise of special precautions. Among the various observations recorded as examples of variation due to natural crossing are colour variations in *Lathyrus sativus*, change of form in tobacco plants, and petal modifications in the opium poppy.

ABOUT four years ago a first catalogue of fifteen pieces of apparatus designed by Prof. W. F. Ganong to serve as instruments for precise measurements in vegetable physiology was issued by the Bausch and Lomb Optical Co., Thavies Inn, Holborn Circus. Those instruments included demonstration clinostat, portable clamp stand, normal light screen, respirometer, leaf-clasp, and bell-jar support. A short supplement to the former catalogue has recently been published, in which new instruments in the form of two space markers and a demonstration auxograph are described. The more useful space marker for root-growth measurements consists essentially of a wheel fitted with a ribbed rubber rim, the ribs being spaced 2 mm. apart. The auxograph is a continuous recording instrument, in which the adjustment of the connection between the growing organ of the plant and the recording pen and other details are carefully devised.

THE survey of the Philippine Islands has advanced steadily since it was undertaken by the Coast and Geodetic Survey of the United States ten years ago. A considerable length of coast-line has been accurately located by triangulation, and a belt of country along it has been surveyed topographically. The hydrographic survey of the waters between the numerous islands has also been vigorously pushed on, 120 charts having already appeared. A map showing the present state of the work appears in the January number of *The National Geographic Magazine*.

THE first number of the Technical Review of the Venezuelan Ministry of Public Works mainly consists of official decrees and regulations, but a small amount of information relating to the country appears in the form of communications from commissions entrusted with exploration of eastern and western Venezuela. The geographical positions of sixteen places in the district of Lara were astronomically determined, and a few notes on the geology and meteorology are added. Similar data are furnished from the country to the southward, and the meteorological observations taken at the Observatory of Cajigal in 1908 are included.

A SUMMARY of the state of the ice in the Arctic sea during the summer of 1910 has been published by the Danish Meteorological Institute. The White Sea was open early, and in the Barentz Sea also the winter ice broke up in May, though the polar ice remained dense. Round Spitsbergen conditions were severe, but in the Greenland Sea, on the other hand, they were normal, and the coasts of Iceland were almost free from ice, though in April and May it was not far from the north-west of the island. The opinion is expressed that there will probably be much ice this spring in the Barentz Sea and to the south of Spitsbergen, while normal conditions are anticipated in Davis Strait, Baffins Bay, and to the east of Newfoundland.

MR. H. J. MACKINDER, M.P., lectured on Monday, March 27, before the Royal Geographical Society on the subject of "The New Geography, its Aims and Methods," wherein he reviewed the present outlook of the geographer in this country and compared it with that of four-and-twenty years ago, when he last discussed the scope of geography before the society. After stating that the geographer in his maps sees the earth's surface and its form, that he studies its history, and appreciates the influence of this upon man, his distribution, development, and history, the lecturer went on to demonstrate that with such an outlook geography became an independent subject of study, teaching, and research. By means of a few selected instances the influence of the physical character of a district on its human history was shown, and the ineffectiveness of historical study without a clear perception of the physical controls was insisted upon. Education on such comprehensive lines may be trusted to give a width of outlook and a power of visualising the relations of a number of factors which must give added power in any branch of knowledge. Research can find ample scope in investigating the effect of the relations between the various physical and human factors, thus furnishing a firm basis for the generalisations of the geographer; and for those whose interest is directed to special branches of the subject, the critical examination of problems arising in them affords opportunities for every geographer so long as he bears in mind its relation to the subject as a whole, and would not restrict the subject to the limits of that portion in which his interest lies.

THE Transactions of the Geological Society of South Africa include (vol. xiii., 1910, pp. 65–92, Plates ii.–ix.) an interesting paper, by Mr. C. B. Horwood, on the carbon found in the banket of the Rand. Mr. Horwood holds that there is some close connection between the presence of the carbon and that of the gold. He holds that the carbon has been deposited, at least in its present position, by secondary action, and that the carbon was probably introduced as a hydrocarbon. He quotes, with apparent approval, Mr. Coste's view that petroleum has a solfataric volcanic origin. Mr. Horwood holds that the carbon at the Rietfontein Mine is usually an indication of the presence of visible gold, and that "where carbon is present good gold values may confidently be expected." According to his account, it appears that it is only occasionally that carbon can be detected in the pay-reefs, and that it is only on the Rietfontein and the Randfontein Mines on the Rand that sufficient carbon occurs to be a characteristic feature of the banket. Carbon is apparently most abundant in the abandoned Buffelsdoorn Mine, which, however, is at Klerksdorp, and not on the Rand. Mr. Horwood's valuable analyses throw doubt on his view that the carbon has been the precipitant of the gold owing to

the very sparse occurrence of the carbon and the lack of agreement between the amounts of carbon and gold. Thus, according to Mr. Horwood's table of analyses of samples from the West Reef dyke of the North Randfontein Mine (Appendix D, p. 92), one of the three specimens containing the highest percentages of carbon had the smallest weighable quantity of gold, and of the two specimens with the highest percentage of gold one had only a trace of carbon, and the other was one of the lowest in carbon in the whole series. Mr. Horwood bears fresh testimony to the fact that throughout the Rand good values are almost invariably found when pebbles of a pinkish-brown quartzite occur in the banket.

To the *Sitzungsberichte* of the Vienna Academy of Sciences (July, 1910), Dr. W. Schmidt contributes a lengthy investigation on thunderstorms and squalls, rapid rises of barometric pressure. The work is divided into two parts:—(1) the observations and results of sixteen months' records of the variometer at the Central Meteorological Office at Vienna, especially with reference to the cases of rapid rises mostly caused by squalls, &c.; (2) experimental investigations of the incursion of heavier (colder), under lighter (warmer) air, and its effect on the formation of the squalls. The latter subject constitutes the essential part of the whole investigation, and this inflowing of the cold air, the author states, never takes place in the form of a simple wedge, but the front portion has the shape of an uplifted head (illustrated in the diagrams). "This head, with the currents that it causes, is the core of the squalls and thunderstorms. In these we cannot therefore speak of an actual whirl with horizontal axis." He considers that another theory must be substituted for the old one, which would explain all the phenomena in squalls essentially by the motions which, under the influence of gravity, must take place from the juxtaposition of two layers of air at different temperature.

The *Zeitschrift für den physikalischen und chemischen Unterricht* issues from time to time special parts dealing with the method of teaching and the philosophy of science. In a part of 120 pages, which has recently appeared, Dr. H. Lüdtke, of the Modern High School (Real-Gymnasium), Altona, gives details of a course on electrical oscillations and the electromagnetic theory of light suitable for the older pupils in modern high schools. It includes construction of a Tesla transformer, experiments to show the repulsion of a metal disc and other mechanical actions of the currents obtained, together with their thermal, optical, chemical, and physiological effects. The portions of the theory of alternating currents necessary for the study of the theory of light are then introduced, and are followed by experiments on electrical oscillations, their interference, diffraction, and polarisation. The course is well thought out, both theoretically and experimentally, and will commend itself to those high-school teachers in this country who have the time and apparatus necessary for the preparation of a course on the subject, and the pupils capable of benefiting from such a course.

A small portable photometer, known as the "Holophane Lumeter," for determining the luminosity of surfaces, has been constructed by Messrs. R. and J. Beck. It measures 8½ by 2¾ by 2¾ inches, and is divided into two chambers, the first of which contains a small electric lamp run from two storage cells. The light from this chamber, the walls of which are painted white, passes through a small opening into the second chamber, which contains the circular photometer screen. The matt-white surface of the screen is viewed through an eye-piece inserted obliquely into the side of the chamber. The surface the luminosity of which is to be determined is seen through an opening in the centre of the screen, and a corresponding one in the end of the chamber. Two sectors, one notched, the other plain, can be moved over the aperture between the two chambers until the brightness of the outer part of the photometer screen is equal to that of the central part. The luminosity of the surface viewed is read on two scales outside the box, over which two pointers connected with the sectors move. One scale reads up to 0·1 and the other to 1·0 candle foot. By means of dark glass screens interposed in the path of the light coming from the surface tested, the readings may be extended up to 100 candle feet. The instrument is standardised by being made to read 1·0 when directed to a white surface 1 foot away from a standard candle.

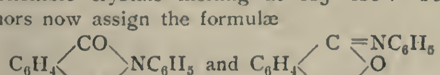
Messrs. Newton and Co., 3 Fleet Street, have just issued a new price-list of X-ray, high-frequency, and electro-medical apparatus. The X-ray apparatus shows evidence of development in several directions. The "Snook" apparatus consists essentially of a step-up transformer immersed in a tank of oil. The primary receives alternating current from a dynamo, which is worked from the electric supply mains. A simple mechanical high-tension commutator is placed in the secondary circuit, and renders the secondary charge unidirectional. The axis of the commutator is continuous with the axis of the dynamo, and thus perfect synchronism must necessarily result. From a convenient switch table the secondary discharge can be regulated from a very small to a very large one. The introduction of this apparatus has led to modifications and improvements in all other forms of generating apparatus; coils have been constructed with a large amount of metal in the core, and a comparatively thickly wound secondary, so as to be capable of giving large discharges comparable with those obtained from the secondary of the "Snook." Mechanical and electrolytic interrupters have also been developed and enlarged in such a way as to enable large primary currents to pass through them.

No marked development has taken place in X-ray tubes in recent years, but there are several on the market now which are able to stand a heavy secondary discharge, and thus enable skiagrams of the thicker parts of the body to be taken with very short exposures. The accessory apparatus described in Messrs. Newton and Co.'s list referred to above includes certain devices for the protection of the operator. One of these is a lead-lined cabinet in which the observer and one or two others can incarcerate themselves while the X-ray tube is in action. The switchboard is placed in the cabinet. A cabinet of this sort was introduced some years ago by Dr. Albers-Schönberg, of Hamburg. Its utility is confined to cases in which X-ray treatment is to be given, or an X-ray photograph is to be taken, though it is obviously of no use for fluorescent-screen observation, a most important part of diagnostic X-ray work. For protecting the operator during fluorescent-screen operations, Dr. Jordan's adjustable lead-lined screen is illustrated, and also the revolving saddle upon which the patient is seated during the use of this lead-lined screen. Several old patterns of tube stand are still figured in which the X-ray tube is not enclosed in a protective shield or box. Thus on p. 69 two naked X-ray tubes are shown supported by a single jointed clamp. No X-ray tube should ever be used in this unprotected state at the present day, and it would have been better to have omitted such stands from the price-list, as they are a source of danger to those who use them.

UNDER the title "Chemische Weltliteratur," Dr. Wilhelm Ostwald communicates an article to the current number of the *Zeitschrift für physikalische Chemie* which raises a question of very general interest. He points out that the convention under which all scientific publications are published in one of the three "great" languages (English, French, or German) shows signs of breaking down. Partly through an increased sense of nationality, partly through the difficulty of writing freely in a foreign tongue, numerous valuable publications are now published in Italian, Spanish, Russian, Polish, and other languages. This tendency renders it difficult, if not impossible, for a worker in any given branch of science to learn what has already been done in his own subject. Dr. Ostwald then discusses the possibility of an agreement on an international speech for scientific publications. Owing to the large number of new conceptions and terms, the use of Latin for this purpose is no longer possible, and *Ido*, an improved and developed Esperanto, is suggested as a solution. A general outline of this artificial language is given, and a nomenclature especially adapted to chemistry is sketched out. The subject is one which might well receive attention at international scientific congresses, and if it were possible to arrive at a general agreement, even in one or two isolated sciences only, a real step in the diffusion of science would be made.

WE have received from the publishers, Gebrüder Borntraeger, of Berlin, the first number of a new magazine entitled *Internationale Zeitschrift für Metallographie*. Although published in Berlin and edited by Dr. Guertler in that city, the new journal aims at an international character, and the list of collaborators includes the names of the leading workers in metallography in this country, as well as in Germany, America, Sweden, and Italy. The journal is intended for the publication of papers in German, English, or French dealing with the whole range of metals and alloys, each paper being accompanied by a brief abstract in all three languages. If the new journal can secure the necessary contributions in such a way as to avoid the wide scattering of metallographic papers which now occurs, it will prove extremely useful. It is, however, recognised that British authors who are accustomed to present their work to scientific or technical societies will not be able to abandon these in favour of the magazine; such papers are therefore either to be reprinted in full or to be fully abstracted. The present number of the journal contains introductory matter by the editor, and two papers of some interest, one by Profs. Heyn and Bauer (Berlin) on internal stresses in cold-wrought metal, and the other by Prof. Mathewson (U.S.A.) on sodium-silver alloys. The experiment of establishing an international journal of this kind is an interesting one; if successful, it may lead to similar developments in other branches of science.

A RECENT issue of the Memoirs of the College of Science and Engineering, Kyoto Imperial University, contains two interesting papers on isomerism of different types. In the first paper, by Prof. Kuhara and Mr. Komatsu, on isomeric phenylphthalimides and some allied compounds, the authors describe a number of pairs of isomeric derivatives of phthalimide. The parent substance is only known in one form, but phenylphthalimide has been obtained in colourless needles melting at 83°–84°, and in yellow rhombic crystals melting at 125°–126°. To these the authors now assign the formulæ



(Colourless) (Coloured)

Similar formulæ are assigned to the colourless and yellow isomeric compounds prepared by the interaction of phthalyl chloride with six substituted anilines, and also to the colourless and yellow *p*-methoxy- and *p*-ethoxy-phenylphthalimides prepared some years ago by Piutti and Abati. The isomeric compounds yield identical derivatives when acted upon by the Grignard agent. The second paper, by Prof. Kuhara and Mr. Todo, deals with the Beckmann rearrangement. The authors conclude that the interchange of radicles which takes place, *e.g.*, by the action of benzenesulphonic chloride on benzophenoneoxime is due to the dissociation of an acid radicle from the nitrogen atom

$$\begin{array}{c} C_6H_5.C.C_6H_5 \\ \| \\ N.O.SO_2.C_6H_5 \end{array} \rightarrow \begin{array}{c} C_6H_5.C.C_6H_5 \\ \| \\ N\ldots OSO_2C_6H_5 \end{array} \rightarrow$$

$$\begin{array}{c} C_6H_5.C.O.SO_2.C_6H_5 \\ \| \\ N.C_6H_5 \end{array}$$

A compound of the latter type, having the formula

$$\begin{array}{c} C_6H_5.C.O.CO.CH_3 \\ \| \\ N.C_6H_5 \end{array}$$

has actually been prepared as an unstable yellow oil, and has been shown to pass over at once into benzanilide when acted on by hydrochloric acid.

THE new edition—the third—of Prof. Karl Pearson's "Grammar of Science" is to be issued by Messrs. A. and C. Black in two volumes, the expansion of the text having rendered it too large for one volume. There will be an entirely new chapter dealing with birth-rates, race suicide, and degeneracy. The first volume will be published immediately, and the second volume in the autumn of this year.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR APRIL:—

April 1. 5h. 45m. Venus in conjunction with the Moon (Venus 0° 14′ N.).
9. 7h. Neptune at quadrature to the Sun.
14. 15h. Mercury at greatest elongation east of the Sun (19° 42′ E.).
14. 17h. 6m. Jupiter in conjunction with the Moon (Jupiter 1° 41′ N.).
19. 23h. Uranus at quadrature.
23. 13h. 11m. Mars in conjunction with the Moon (Mars 3° 45′ N.).
24. 20h. Mercury stationary.
28. 10h. 16m. Sun eclipsed, invisible at Greenwich.
28. 14h. 46m. Saturn in conjunction with the Moon (Saturn 2° 17′ S.).
29. 10h. Venus in perihelion.
30. 16h. Jupiter at opposition to the Sun.
30. 18h. Saturn in conjunction with the Sun.

OBSERVATIONS OF THE ZODIACAL LIGHT.—Some interesting observations, illustrated by sketches, of the Zodiacal Light are recorded by Herr Hoffmeister in No. 4484 of the *Astronomische Nachrichten*. The observations were made at Sonneberg, Thüringen, during February and March, 1910, when, it will be remembered, the light was particularly visible during the apparition of comet 1910*a*, which is shown on one of Herr Hoffmeister's sketches (February 3). On this date, at 7h. 10m. (M.E.T.), the summit of the brightest portion of the Light was at $\alpha = 17°$, $\delta = +10°$, and on March 5, at 8h. (M.E.T.), it lay in the position $\alpha = 33{\cdot}5°$, $\delta = +15{\cdot}5°$; Herr Hoffmeister also gives the positions of a number of points marking the northern and southern limits. To provide a scale for the brightness of the various parts of the Light, Herr Hoffmeister selects and names various parts of the Milky Way with which he compared it; this scale, of five steps, should prove useful in making comparisons of the Light from time to time.

THE ADOPTION OF STANDARD TIME IN FRANCE.—To *La Nature* (No. 1970) M. H. Cathenod contributes an interesting illustrated article on the international system of standard time, to which France has now given its support. He outlines the history of its general adoption, the reasons for accepting the Greenwich meridian as the basis of the system, and the reasons for France's hesitation in entering the international agreement earlier. The article is usefully illustrated by a number of sketch-maps, and, in concluding it, M. Cathenod reiterates M. Faye's hope that, in return for the international adoption of the Greenwich meridian as the point of departure, Great Britain will favour the unification of the system of weights and measures by adopting the metrical system.

THE DIFFERENT FORMS OF HALOS AND THEIR OBSERVATION.—Although a large number of famous astronomers and other observers have directed their attention to the halos which are to be seen from time to time surrounding the sun or moon, these phenomena still present some unsolved problems. In the March number of *L'Astronomie* Dr. Besson, of the Montsouris Observatory, suggests that the observations should be made regularly by amateurs, for the phenomena are visible without the help of instruments; but the amateur often lacks the knowledge of what to look for and what is worth recording. To remedy this state of affairs, he gives some excellent descriptions and instructions well illustrated by numerous diagrams.

Two of these diagrams show the solar halo of 22°, the halo of 46°, the upper and lower tangential arcs, the parhelia and anthelia, the oblique arcs and the luminous column and the arcs of Lowitz. Each phenomenon is then described and discussed, so that the observer may know when and where he may expect to see it, and what colours, if any, should attend it. Special notes and a diagram are given for the circumzenithal arcs, which are not so frequently seen, and generally last not longer than five minutes. M. Besson finds that the observations published in late years favour the theory of Bravais as to the appearance of these arcs, a theory which Pernter did not accept. This article is to be followed by another, in which the author will describe some of the rarely seen and abnormal phenomena which attend the apparitions of halos.

NOVA LACERTÆ.—In an article which appears in No. 9, vol. civ., of *The Scientific American*, Prof. S. A. Mitchell gives some very interesting facts concerning the apparition of Nova Lacertæ and the discovery and nature of novæ in general. Since the first recorded nova, that of Hipparchus in the year 134 B.C., only thirty-six new stars have been observed, and of these eighteen have been discovered since 1885; fifteen of these have been first found on photographs, and, of the fifteen, fourteen were discovered at the Harvard College Observatory from plates taken there or at Arequipa.

The photographs of Nova Lacertæ taken by Profs. Barnard and Wolf show that between November 19 and 23, 1910, the light of the star increased 4000-fold. A spectrum secured by Prof. Frost, using the 40-inch refractor at the Yerkes Observatory on January 3, is stated to be exactly analogous to those of Nova Aurigæ and Nova Persei, so that any explanation which accounts for their peculiarities will also explain Nova Lacertæ. Prof. Mitchell discusses, very briefly and generally, the causes which may produce novæ, and shows that the "pressure" theory and the "collision" theory leave much to be explained; he rather favours the passage of a rapidly moving star through a previously unknown nebula. The article is well illustrated, the reproductions including photographs of the Harvard College observatories at Cambridge (Mass.) and at Arequipa.

THE STAR LIST OF THE AMERICAN EPHEMERIS, 1911.—For thirty years (1882–1911) the star list of the American Ephemeris has given ten-day ephemerides for the apparent places of some 378 especially chosen stars, and daily ephemerides for five circumpolar stars. The need of a larger and improved star list for the use of astronomers, engineers, and surveyors prompted the issue, in 1908, of the list of 780 stars for 1909, and the present issue is similar to that except that forty-five more stars have been added. As the Ephemeris for 1912 contains a list identical with the present issue, the publication of a separate Star List will not be continued.

EPHEMERIS FOR WOLF'S COMET.—In No. 4483 of the *Astronomische Nachrichten*, M. Kamensky continues his ephemeris for Wolf's comet, which may return to perihelion in February next. At present the comet is apparently in Aquila, about half-way between δ Aquilæ and η Serpentis, and is moving in a north-easterly direction; its calculated magnitude is about 14.

ANTARCTIC EXPEDITIONS.

THE centre of interest in polar exploration has been shifted, earlier than might have been expected, from the north to the south by the telegram forwarded from Stewart Island from the returning *Terra Nova*. This vessel has carried Captain Scott's expedition to its base successfully in spite of encountering heavy pack-ice in the remarkably low latitude of 65° S., and having to make 380 miles of difficult travelling through it. The telegram includes messages from Captain Scott and from Lieut. Pennell, the officer commanding the *Terra Nova* on her return, and it is in the latter message that the salient point of interest is found, namely, the discovery of the celebrated *Fram*, with Captain Amundsen's expedition aboard, already established in the Bay of Whales, an inlet in the ice-barrier at 165° W. long. It is perhaps early as yet to account for Amundsen's change of plan (for he originally sailed ostensibly with an Arctic journey in view); the interest of the moment is that, assuming his base to be established at the Bay of Whales, he is nearer the Pole by nearly 100 miles than Scott if he elects to strike south in a direct line, and risk discovering a new route up to the polar plateau. If, however, he makes for Shackleton's known route (which Scott, of course, will follow) up the Beardmore glacier, he will have little if any advantage in distance.

Some uncertainty as to Scott's arrangements is caused by the messages. His own states that after leaving him at the base in McMurdo Sound the *Terra Nova* would leave a geological party on Victoria Land, and then proceed to leave an exploring party on King Edward Land. As a fact, it appears that the *Terra Nova* proceeded along the ice-barrier towards King Edward Land first, failed to make a landing at Cape Colbeck, and returned to the Bay of Whales. Here the *Fram* was found, and here two interpretations have been put upon the message:—"The *Fram* is proceeding to Buenos Aires, returning the following season to re-embark Captain Amundsen. Stores were landed and a hut erected two miles from the ship, and the *Terra Nova* afterwards left again for McMurdo Sound."

Some commentators refer the stores and hut to the party from the *Terra Nova*, which seems the more probable on the face of the sentence; others suspect wrong paragraphing, and suppose the stores and hut to belong to Amundsen's party. Later the ship was driven north, and landed the "eastern" party at Cape Adare (Victoria Land), which would suggest that the second group of commentators are right, and leaves it uncertain as to what has become of the geologists. This will doubtless be cleared up when the ship reaches another cable station; in the meantime, it seems reasonable to hope that there will be room in Victoria Land for Scott's party (especially if they are geologists only) and the expedition of Dr. Mawson, who has expressed some doubt as to the inviolability of his province.

Scott, Amundsen, and Mawson (who will have as commander Captain J. K. Davis, late of the *Nimrod*) do not exhaust the list of those already attacking or intending to attack the problems of the south. A Japanese expedition under Lieut. N. Shirase, having little in common with European equipment beyond a characteristic determination, was reported to have left for the south at the end of last year. Nor is it certain that an American expedition has been given up, in spite of Commander Peary's determination not to lead it, for it is stated that his captain, Bartlett, is ready to take his place.

It may be added that already Scott's expedition has added something to scientific knowledge, for those returning on the *Terra Nova* have carried the north coast of Victoria Land (by distant sights) some 150 miles beyond its previously known extension, and the interesting feature of an open sea immediately south of the Balleny Islands was encountered.

THE USE OF RADIO-ACTIVE SUBSTANCES IN THERAPEUTICS.

THE *British Medical Journal* for February 4 contains a report of an address delivered before the Berlin Medical Society on January 18 by Prof. Wilhelm His, of the University of Berlin, on "The Treatment of Gout and Rheumatism by Radium." Prof. His was led to make the investigations upon which the address was founded by the consideration that radium, or at all events some of its derivatives, formed a constituent of certain natural curative springs, the action of which on gout and rheumatism is undoubted, though medical men have not been able to explain it satisfactorily. It soon became evident that both radium and radium emanation were capable of producing cures, which were especially remarkable in the case of gout and of the various rheumatic affections. The results obtained were reported by the lecturer about a year ago to the German Balneological Society. Since then his experience has considerably extended.

The patients dealt with include 100 cases of chronic rheumatism and 28 of uric acid gout. Of the former, 47 were improved, 29 considerably improved, 5 nearly cured, while 19 were uninfluenced by the treatment. The most interesting of the cases were those in which limbs rendered useless by the disease were almost completely restored by the treatment, which was continued for periods of three months or longer. In gout, the results were much more striking. Twenty-eight patients were kept under treatment and under observation for a considerable period. Of these, 4 remained unaffected, while in 24 a marked improvement in the condition was achieved. Some of the patients have remained free from symptoms for a year after the termination of the treatment.

The most remarkable effect is noted in the behaviour of the uric acid in the blood. Under the influence of radium emanation, the blood loses its uric acid within a few weeks. This was observed in 15 cases out of 18. On the other hand, the uric acid persisted in the blood of 3 patients even after a severe course of treatment. On two occasions actual deposits of uric acid under the skin of the ear (so-called "tophi") were seen to disappear during the treatment. The clinical improvement did not always run parallel with the uric acid content of the blood. Thus very marked improvement was obtained in a patient by energetic treatment, though the blood continued to contain uric acid. In another patient no uric acid was present in the blood either at the beginning or the end of the treatment, although he had gouty nodules all over his body.

When water containing radium is drunk, part of the emanation is taken up in the inspired air, and another part is absorbed from the stomach and intestine. Emanation behaves like every other gas which is not a normal constituent of the body. It is excreted to a very slight extent through the kidneys, and to a large extent in the expired air. When the treatment is carried out by baths, absorption is only continued so long as the patient remains in the atmosphere laden with emanation from the bath water, and the foreign gas is excreted immediately. On the other hand, when carried out by means of drinking waters, the absorption takes place slowly from the intestine, and the body is being constantly supplied with fresh doses of emanation for three or four hours after a single dose. When the patient is given from three to five doses during the day, emanation can be detected in the expired air at any period of the day.

Radium itself behaves in the body like other heavy metals; that is to say, it is absorbed slowly, and the absorbed quantity is excreted again through the intestine. So long as it is present in the body, small quantities of emanation are continuously developed from it. It is therefore clear that the most active application of emanation is achieved when the individual is breathing an atmosphere which contains a certain quantity of radium emanation. Under these conditions, an equilibrium will rapidly be established between the emanation content of the outer air and that of the blood. This equilibrium will be maintained so long as the body remains in this atmosphere. The emanation content of the blood will reach a level in this way which can only be attained by the drinking of exceptionally large quantities of water containing radium. Experiments have shown that it is usually sufficient for the purpose of obtaining definite curative results, and of ridding the blood of gouty patients of uric acid, to place the patient in an air containing from two to four "making units" per litre for two hours a day. "Emanators" have been constructed on this principle. A stream of oxygen bubbles through a fluid containing a salt of radium and is saturated with emanation. The emanation issuing from the fluid is distributed equally in the air of the room by a ventilator. This method, however, has the disadvantage that it can only be applied when a special emanator is available. A portable inhalation apparatus has also been constructed.

With regard to the mode of action of radium, the most important factor appears to be the property possessed by radium of rendering various ferments of the body more active than usual. This power of activising ferments has been demonstrated in the case of pancreatin, pepsin, lactic acid ferment, diastatic ferments, and autolytic ferments. It is probable that the same is true of numerous other ferment actions in the body, though not for all; for example, it is known that the excretion of sugar by diabetics is not influenced by radium. In the case of gout, this property of radium can be demonstrated in a very clear manner. The disturbance in gout has been shown to depend on a slowing of the purin body metabolism, and not only is the formation and breaking down of uric acid slowed, but the mutual relations of the two processes are altered. In the gouty this is shown by the fact that, on a diet free from purin, though containing nucleic acid, the uric acid formed is not completely excreted within five days, as is the case in healthy persons. After prolonged treatment with emanation, however, the excretion takes place as promptly and completely as in a healthy individual. Gudzent was further able to show that uric acid and its salts are dissociated into carbon dioxide and ammonia under the influence of this action, and he demonstrated in a very ingenious manner that neither radium nor radium emanation produces this dissociation. It is due to radium D. Thus the actions that come into play in the treatment of gout by radium are very varied. In addition to the autolytic action, the action inhibiting inflammation, and that alleviating pain, there is a specific action on the uric acid and its salts, and on the processes regulating the quantity of uric acid in the body.

Another radio-active substance—mesothorium—has been prepared in considerable quantities by Dr. Otto Hahn. As compared with radium, the want of durability of this preparation is amply compensated by the greater ease with which it can be obtained from raw material. It is more than probable that other radio-active substances will be discovered, and will bring the treatment of gout and allied complaints by radio-active substances within the reach of all. A great deal of experiment and observation is still required, more particularly to make sure that no evil results may appear side by side with the undoubted benefit which has already been obtained.

A. C. JORDAN.

THE AERO AND MOTOR EXHIBITION.

THIS exhibition opened at Olympia on Friday, March 24, and will continue until Saturday, April 1. A general survey of the flying machines shown indicates that the crank inventor is less conspicuous than has been the case at former exhibitions, and that the British makers have achieved notable progress during the past twelve months both as regards design and workmanship. Most of the machines have evidently been designed and constructed with a view to military requirements. Thus among foreign machines is the Breguet three-section military biplane, one of the favourites with the French War Department. This machine is built almost entirely of steel, thus cutting down the number of parts and the amount of wiring. The spars of the wings consist of large diameter steel tubes, to which the ribs are elastically attached, forming a supple surface which is claimed to give almost entire automatic stability. Another French War Department machine is the Nieuport two-seater monoplane, chiefly remarkable for its high speed—63 miles per hour.

Graham-White has a small biplane on show. This machine has a span of 27 feet and an overall length of 32 feet, and is fitted with a Gnome engine of 50 horse-power driving a four-bladed propeller. On account of the small span and chord, the machine is exceptionally fast, and has been repeatedly flown in gusty winds of velocity up to 35 miles per hour. Aluminium has been entirely dispensed with in the construction, the whole of the fittings and connections being of steel. The machine can be separated into three sections for transport.

The British and Colonial Aëroplane Company, Ltd., exhibit three of their now well-known Bristol machines, a military biplane, a racing biplane and a monoplane. The planes in the biplane type are so shaped—from experimental evidence—that a considerable amount of lifting power is in reserve under normal conditions of flight. The Gnome engine is used by this firm, who are the sole agents for it in Great Britain and the Colonies.

The Sanders Aëroplane Co., of Beccles, Suffolk, and London, exhibit a biplane having some novel features. The extreme tips of the upper planes dip downwards, both upper and lower planes being set at a dihedral angle. There is a biplane elevator in front and a triplane rudder at the rear. Balancing planes are placed between the main planes, and no tail plane is fitted. The peculiar shape of the wings is claimed to give great stability, even in high winds. The main frame of this machine has diagonal braces consisting of flat steel strips. The carriage comprises two skids, and is fitted with two wheels which draw up under the body when released by a trip device, enabling the machine to alight on the skids alone. The outer portions of the main planes are hinged to the central portion, and may be folded inwards for convenience in storage and transport.

Among historical machines shown by the Royal Aëro Club is the Blériot monoplane on which Graham White won the Gordon Bennett Cup at Belmont Park in October, 1910; the Howard Wright biplane with which Sopwith won the Baron de Forest prize of 4000*l.* by a flight of 169 miles, from England to Belgium, in 3½ hours; and the Cody biplane, with which Mr. Cody won the British Michelin Cup. The latter is fitted with a Green four-cylinder engine. The Blériot machines shown in another part of the exhibition are fitted with small skids at the rear in place of the single wheel present in last year's machines.

Many well-known types of engines are exhibited, those most generally in evidence being the Gnome and the Green. The Isaacson engine, made at the Boyne Engine Works, Leeds, at first glance might be mistaken for a Gnome. It has seven radial air-cooled cylinders, which, however, do not revolve. The casing enclosing the crank also contains a two to one reducing gear, so that the propeller, which is coaxial with the crank shaft, rotates at half its speed. The development of this engine will be watched with interest.

THE GLANDS OF RUMINANTS.

In the issue of the Zoological Society's Proceedings for December, 1910, Mr. R. I. Pocock makes an important addition to our knowledge of the specialised skin-glands of ruminants. The value of this communication lies in the fact that it is largely based on the examination and dissection of animals from the society's menageries, whereas, with the exception of the observations published years ago by Brian Hodgson, much of our previous information appears to have been gleaned from museum specimens, which are obviously ill-suited for a study of this nature. The most common of these glands occur near or between the base of the front surfaces of the hoofs (pedal), on the carpus or "knee," where they form tufts in numerous antelopes, on the tarsus and metatarsus of many members of the deer-tribe, on the face below the eyes (preorbital), and in the groin (inguinal). After a review of the structure of these glands, their occurrence or absence in various genera, and their taxonomic value, the author discusses, firstly, their function, and, secondly, their origin and evolution.

As regards function, Mr. Pocock is of opinion that the limb-glands and hoof-glands are mainly for the purpose of tainting the grass or ground through or on which the animals have passed, or upon which they have lain, thereby serving to indicate to the members of a species the whereabouts and the reposing-places of their fellows, the inguinal glands of sheep and many antelopes corresponding practically, so far as their function is concerned, to the tarsal and metatarsal glands of deer. The preorbital glands, on the other hand, appear to be connected to a considerable extent with the sexual function, although it is possible that they may likewise help in directing the members of a herd to the line taken by those in advance.

In structure the preorbital glands range from a more or less complexly invaginated sac to simple glandulation of the surface of the skin; and it appears that the knee-glands of gazelles and the tarsal and metatarsal glands of deer are of the latter simple type, the glandular area itself being naked in a few deer. The glands in the groin, on the other hand, seem to be intimately connected with the milk-glands, their secretion in some instances having an odour like that of sour-milk. The interdigital, or hoof, glands take the form of invaginated sacs of varying degrees of complexity, and appear to attain their fullest development in the type of foot characterised by a long cleft between the toes in front and of a web connecting them behind, such as is found in deer, sheep, and many antelopes. Such deeply cleft and highly glandular feet must apparently be a source of weakness to bulky animals which move rapidly on hard ground; and there accordingly seems to be a tendency in such species to strengthen the foot by obliterating the cleft, with the more or less complete loss, not only of the interdigital, but of all limb glands. The culmination of this takes place in cattle, which lack glands both on the limbs and on the face.

Apart from the consolidation of the foot and the loss of the interdigital glands, the total absence of glands in the members of the ox and buffalo group may, the author suggests, be accounted for as follows:—

"Large ruminants," he writes, "are much more easily kept in view by members of their own species than small ones; or, if they live in thick bush, are more easily followed by hearing, as they crash away in a state of panic through the vegetation." It is added, however, that these and kindred subjects cannot be fully or definitely explained in the present state of knowledge. R. L.

SOME NEW SOUTH AFRICAN MARINE ANIMALS.[1]

The volume referred to below contains a report on the material collected during the investigations of the Cape Government, carried out under the direction of Dr. Gilchrist. The larger part of the report is contributed by Prof. R. Bergh in a paper on South African opisthobranchs (with fourteen plates). Prof. Bergh is able to make a large addition to our knowledge of these animals, since only five species have been previously recorded in this region. He describes eight apparently new Aplysias, a Cape Philine, and other new tectibranchs. Many new holohepatic nudibranchs were found, including a second species of Kalinga. Several new cladohepatic nudibranchs are also described, the most interesting of which is placed in a new genus as *Tritonidoxa capensis*. The paper is illustrated by numerous valuable drawings of organs of specific differential value, and there are two coloured plates.

In looking over Bergh's anatomical contributions, one concludes that he must have many valuable drawings of complete systems of organs, as, for example, of the genitalia. There is no doubt that the publication of more of such drawings would be warmly welcomed by students of nudibranch anatomy.

Reviewing the faunas of the coast west and east of the Cape of Good Hope Peninsula, Bergh points out that the former has a more northern character, with occasional tropical nudibranchs, while the latter is more tropical.

Dr. Gilchrist has an interesting contribution on three new forms of hemichordata: a new species of Phoronis, *P. capensis*, the behaviour and habits of which are interestingly and fully described, and a form which differs

[1] "Marine Investigations in South Africa." Vol. v. Pp. 198. From the Transactions of the South African Philosophical Society, vol. xvii. (Cape Town: Published by the Society, 1908.)

from the typical Phoronis in having an involution of the epidermal cells below the œsophageal nerve collar; it has been allotted to a new genus as *Phoronopsis albomaculata*; the third form is a Ptychodera, *P. capensis*, a brief preliminary description of which is given.

In a short paper Miss Lydia Jacubowa describes a new species of Plarocera, *P. gilchristi.*

Dr. Calman contributes an account of a parasitic copepod from *Cephalodiscus gilchristi* from the Cape Seas. An interesting point about this new form is that it is referable to the family Ascidicolidæ as *Zanclopus cephalodisci* (nov. gen. et sp.), and is thus closely allied to forms infesting tunicates. The author points out that as the nearest ally of Zanclopus is a form infesting the echinoderm Antedon, the nature of the parasite in this case does not necessarily have any bearing on the chordate affinities of the host; nevertheless, the point has some value in such discussions.

Mr. F. Gordon Pearcey concludes this volume with a paper on the genus Botellina, with a description of a new species, which is a gigantic arenaceous rhizopod, attaining a height of 1 to 2½ inches.

Vol. vi. of the Marine Investigations will be published in the Annals of the South African Museum.

SOME MODERN METHODS OF ORE-TREATMENT.

AT the twentieth annual general meeting of the Institution of Mining and Metallurgy, held on March 22, the new president, Mr. H. Livingstone Sulman, was inducted into the chair, and delivered an address in which he reviewed some modern methods of ore-treatment. At the outset, attention was directed to the increasing complexity of metallurgical science, and the need for specialisation on the part of those engaged in its practice. Each stage of production for every finished metal demands its own specialised services from the miner, the metallurgist, and the metal worker, and the task of each daily becomes more elaborate in detail.

After paying a passing tribute to the debt owing to the technical chemist and the mechanical engineer, who have enriched metallurgical practice with such a wealth of ingenious and useful apparatus, Mr. Sulman passed on to a general review of the metallurgical industry, its conditions and requirements, incidentally touching on some of the more important processes now in operation in the treatment of various metals. Zinc-fume precipitation of gold solutions, oil-flotation in aiding recovery of gold and tin, electrolytic cyanidation, the use of cyanogen iodide and of bromocyanide, of silica sponge brick and other methods, were briefly noted, and the speaker then dealt with the rapid development that has recently come about in the treatment of "complex" ores, in which blende, more or less ferruginous in character, is in intimate physical association with galena and other minerals. The means by which such ores can be attacked may be divided into two broad classes, proximate or mechanical methods, and ultimate or leaching and smelting processes. Among the former, flotation methods (somewhat indiscriminately termed "oil" and "surface tension" processes) are now largely used, though there is still apparently much to be learned in this department, especially with regard to the underlying physical reactions, and the need for a practical solution of the slime problem. Magnetic separation, electrostatic methods, and centrifugal machines are also among the mechanical devices which are still in vogue. In processes dependent on the prior removal of zinc by distillation, comparatively little progress has been made; but the reproach often levelled against zinc metallurgists of being behindhand and incomplete in their practice is unmerited, since the conditions surrounding the reduction of zinc oxide to metal are peculiar, and the reactions involved are so highly endothermic. A feature of the zinc industry is its limitation to comparatively few smelting centres, a localisation due primarily to the necessity for cheap fuel, the occurrence of the peculiar clays required for retorts, and climatic conditions. Ultimate methods of treating complex ores introduce a variety of processes devised to meet diverse circumstances, and include leaching processes, electrolysis, electric smelting, and other means.

Mr. Sulman also touched on the treatment of copper ores, and in this connection led up to the necessity for the conservation of what the present generation is too apt to regard as "waste" tailings, but which in the future, with more advanced methods, may prove to be sources of considerable profit. This question of profit, present or ultimate, should, of course, be the dominating idea in all metallurgical work, for, as pointed out earlier in the address, whilst the labours of the chemist, the physicist, the engineer, the mechanician, and the electrician are all important in their respective spheres, the accountant must in effect dominate all.

THE ORGANISATION OF TECHNICAL EDUCATION.

AN open meeting of the London Branch of the Association of Teachers in Technical Institutions was held on March 25 at the South-Western Polytechnic. The chairman of the branch, Mr. J. Paley Yorke, presided, and Dr. R. T. Glazebrook, F.R.S., opened a conference on the organisation of technical instruction, especially in connection with the higher branches. Dr. Glazebrook's address was confined mainly to the question of the organisation of some form of technical university in London. As a keynote he quoted, from his recent speech at the Guildhall, three main points to the effect that (*a*) an independent faculty of technology in London University had become a necessity; (*b*) definite value should be given to the technical instruction in each London school of technology; (*c*) the technical faculty should have power to confer degrees under conditions which should be laid down by the faculty. He pointed out the difficulties which lay in the way of establishing an independent university of technology, and affirmed that these need not exist if separate and independent faculties were established in the existing university. Moreover, each faculty could be treated as if it were a university. It could have its own active body of control composed of representative business and professional men of wide views and sound knowledge of and interest in local necessities and conditions. This body would be similar to the controlling bodies of such provincial universities as Birmingham or Leeds. It could have its council to keep in touch with the governing bodies of the various institutions in the faculty, to approve the various courses of instruction, and adjust the degree of "recognition" of the work done in each institution. This council should consist of representatives of employers, employees, and teachers. It could also have its board of studies, composed of teachers of various subjects under the faculty, to arrange the educational courses and examinations. These independent faculties would have to be connected in some way to prevent overlapping. This could be done by means of advisory committees which should advise a board of trustees, which would see that the freedom of the faculties was not abused, adjust any differences, and administer finance.

Dr. Glazebrook urged the importance of inter-school courses, and the need of greater facilities to teachers and post-graduate students for carrying out research work at their own institutions, and also at the Imperial College of Science and Technology. Principal Skinner advocated the linking up of the polytechnics to the Imperial College, but did not wish to break connection with the pure science side of the university. His polytechnic was already "thrusting itself into the Imperial College," as Sir Alfred Keogh had urged all polytechnics to do, and was doing inter-collegiate work with it. Mr. J. Wilson emphasised the difficulty of procuring under present conditions that freedom of the faculties which was so necessary. Messrs. H. Ade Clark and W. J. Lineham urged for complete separation on the grounds that sympathy towards technical work was not likely to be forthcoming from the present university. Mr. W. P. Winter urged the adoption of a wider matriculation examination, which would allow a student to qualify without having to take a foreign language. Mr. E. Bates also spoke on behalf of the building trades. Dr. Glazebrook, replying to a vote of thanks, hoped the conference would help to strengthen the evidence which the association had been asked to present to the Royal Commission.

THE DOMINION OBSERVATORY, CANADA.

THE annual reports issued by Dr. King, the chief astronomer, dealing with the work performed at, and by, the Dominion Observatory, are comprehensive volumes worthy of a place on the library shelves of every observatory for the purpose of general reference.

The organisation of a modern astronomical institution is no mean task, and to have the experiments, failures, and successes so clearly set forth as they are in these volumes, for the work is still in progress, is to be counted as one of the important achievements of the Canadian astronomers.

Perhaps the most striking feature of the organisation of astronomical labours in Canada is the manner in which collateral and interdependent researches are brought under the same direction. Dr. King's directorship includes

Observing Tower, 87 feet high, near Bowesville.

seismology, terrestrial magnetism and gravity, astrophysics, meridian work and time service, longitude and latitude observations, spectroscopy and solar physics, with all their subdivisions and ramifications. Such organisation makes for a great saving of time and correspondence; records of one branch are readily available, on the spot, for correlation with those of other branches, and auxiliary researches, such as can be more readily prosecuted in divisions other than that in which the results are actually required, can be readily ordered by the same direction. Unfortunately in this country we, at present, lack such a properly organised institution, although in other countries the opportunity and money to instal them have been found.

The report published in 1910 deals with the work done during the year ending March 31, 1908, and, in 356 pages, includes seven divisional reports, not merely of the work attempted, but the actual results in each division. A few only of the more striking features may be summarised here.

Dr. Klotz is responsible for the geophysical department, and he discusses very thoroughly the working and improvement of the seismographs, &c., and enters into a general discussion of the results. Regarding the suggestion that the boom acts as a delicate barometer, registering the tilting produced by excess or defect of atmospheric pressure, he, as yet, preserves an open mind, although the preliminary discussion of the results, given in detail in the report, indicates a connection between the presence of a "low" over the Gulf of St. Lawrence and the incidence of well-marked microseisms at Ottawa later in the same day. But there are important outstanding differences which call for further investigations.

The magnetic elements, and their variations, are also recorded in full, and the isogonic lines for 1907 are shown on an excellent large map of Canada accompanying the report.

Mr. Plaskett contributes a voluminous and important report on the astrophysical work (pp. 65–273), in which a prominent feature is the investigation of spectroscopic binaries. Those conversant with Mr. Plaskett's published papers will readily understand that a great deal of practical information concerning the apparatus and methods employed makes his report both interesting and useful for reference to those engaged in similar researches. For each star dealt with practically every possible datum is recorded, and the results are carefully summarised and discussed.

Five appendices to Mr. Plaskett's report deal with special researches coming under the head of astrophysics. Of these Mr. Harper contributes two, dealing, respectively, with the orbits of the spectroscopic binaries η Virginis and θ Aquilæ. Mr. Motherwell discusses the measurement of visually double stars, Dr. De Lury gives an account of the determination of the wave-lengths in the spark spectrum of iron-vanadium alloy between $\lambda\lambda$ 3900 and 4900, and Mr. Tobey discusses the photometric observations.

For solar work, the observatory is equipped with a 23-foot plane-grating spectroscope, used with a cœlostat and photographs of the sun, 7½ inches to the solar disc, are taken on every clear day, but during the period covered by the report the solar work was delayed by difficulties in getting the necessary buildings completed.

Mr. Stewart's report on the meridian work and time service also contains many practical hints useful to those engaged in similar work. The observatory controls a number of synchronised public clocks, and the methods of synchronisation are carefully described. Difficulties with the various piers, which cracked under the influence of frost, interfered with the meridian work to some extent, but the account of them affords instructive reading. The primary azimuth-marks are now installed underground, as at the Cape Observatory.

It is interesting to note here the great advantages secured by having a properly equipped workshop attached to the observatory, an institution without which any observatory where a number of instruments are employed in experimental researches is sadly handicapped. At Ottawa—as at Mount Wilson, Mount Hamilton, and many other important observatories—apparatus can be made, or modified, and adapted under the actual supervision of the observer who wishes to use it; and a great deal of time, trouble, and expense often required to instruct the sometimes unadaptable outside mechanician is thereby saved. While there is some satisfaction in constructing an effective piece of apparatus from odd pieces of wood and metal, with the aid of a penknife, the results attained are not, inevitably, always the most satisfactory attainable for the purpose.

The results of the latitude and longitude observations, 1907, are tabulated by Mr. Macara in Appendix 4, and the astronomical stations established up to March 31, 1908, are shown on a large-scale map of the Dominion which accompanies the report. Appendix 6 is a summary of the photographic work, and in the next section Dr. King reprints his paper, from *The Astrophysical Journal*, on the determination of the orbits of spectroscopic binaries.

The geodetic work, whilst primarily utilitarian in character, aspires to take its place among the "great" surveys—for the determination of the earth's figure—and, judging from the results given in Mr. Bigger's most interesting report, it will not be found wanting in pre-

cision. A great deal of work has been performed since its initiation in 1905, despite the fact that the atmospheric conditions in Canada were found to hamper the observations considerably. Very careful investigations of the local, actual conditions have to precede the making of the standard observations. Observing towers—modifications of that designed by Sergeant Beaton—have to be employed, and range in height from 47 to 102 feet; they consist of a tripod upon which the theodolite is mounted, and a scaffold insulating the observer's weight from the instrument. One of these structures, 87 feet high, is illustrated on p. 160, and Mr. Bigger reproduces several other photographs illustrating the method of its erection. The large amount of country already surveyed, and under survey, is shown on the third large map accompanying the report.

In conclusion, it may be stated that the report indicates that astronomy and its allied sciences are being well looked after in the Dominion with an organisation that many workers in the British Isles might well envy, and that, when completed, the Dominion Observatory will properly take its place among the observatories of the world.

W. E. ROLSTON.

A CONSPECTUS OF SCIENCE.

THE annual report of the Board of Regents of the Smithsonian Institution for the year ended June 30, 1909, has been received from Washington. The volume contains the annual report of the secretary, giving an account of the operations and condition of the institution for the year; a report of the executive committee exhibiting the financial affairs of the institution; the proceedings of the Board of Regents; and a general appendix. As in previous years, it is the appendix which gives the volume its unique value. It comprises a selection of scientific and other memoirs of wide interest relating chiefly to the year 1909. Many of these memoirs are translated into English from the languages in which they were written, and thus become much more widely available both in this country and America.

We note among such contributions to the appendix Prof. H. Poincaré's address on the future of mathematics, delivered at the International Congress of Mathematicians in Rome in 1908; Commandant Paul Renard's contribution to the *Revue des Deux Mondes* for November 1, 1909, on what constitutes superiority in an airship; M. L. Marchis' article on the production of low temperatures and refrigeration, in the *Revue générale des Sciences,* March 15, 1909; M. A. de la Baume Pluvinel's paper on solar-radiation researches by Jules César Janssen, from the *Astrophysical Journal,* September, 1908; Dr. Gaubert's essay on the formation, growth, and habit of crystals, which appeared in the *Revue scientifique* of January 15, 1909; M. Maurice Zimmermann's paper from the *Annales de Géographie,* March 15, 1909, on the Antarctic land of Victoria; M. D. Damas' paper on the oceanography of the sea of Greenland, from *La Géographie,* Paris, June 15, 1909; M. Romuald Minkiewicz's contribution to the *Revue générale des Sciences,* February 15, 1909, on the instinct of self-concealment and the choice of colours in the Crustacea; and M. G. Marotel's paper on the relation of mosquitoes, flies, ticks, fleas, and other arthropods to pathology, from the *Annales de la Société d'Agriculture, Sciences et Industrie de Lyon,* 1906.

The appendix also contains several important contributions from British men of science in the form of reprinted addresses. The numerous plates contained in the volume add greatly to its interest.

INSECT AND FUNGOID PESTS.

PROBABLY the most important advances in agricultural and horticultural practice in the present day are in the direction of controlling insect and fungoid pests. Economic considerations generally compel the grower to aim at large crops; in consequence, losses caused by disease may be very heavy. All the conditions of modern cultivation tend to favour the pests; the distribution of seeds and of nursery stock from district to district facilitates the spread of spores and ova, whilst the dense planting and the continuous cropping provide a succession of host plants. Further, the high nitrogenous manuring invariably practised as agriculture and horticulture become more developed seems to increase the susceptibility of the plant to attack. In all countries where agriculture is progressing there is growing up an enormous literature dealing with these pests. A few of the more recent publications only are referred to in this article, but the list does not profess to be complete. Two general methods are in use for combating the pests: natural enemies are encouraged, and, if necessary, introduced into the country, and poisons are applied sufficiently potent to kill the pest, but not the infested plant.

In output of literature the United States easily heads the list. Under the direction of Dr. Howard, the Bureau of Entomology of the Department of Agriculture has accomplished an enormous amount of work of both scientific and technical value. A recent bulletin by H. E. Burke deals with the flat-headed borers (Agrilus), causing damage to forest trees to the extent, it is estimated, of 100,000,000 dollars annually in the States alone. Methods of treatment are now known, and much of the damage can be prevented. The San José scale (*Aspidiotus perniciosus*) is shown by A. L. Quaintance to yield to treatment with petroleum or kerosene washes, or with lime and sulphur washes. "Brown rot" (*Sclerotinia fructigena*) and the plum curculio (*Conotrachelus nenuphar*) are described by W. M. Scott and A. L. Quaintance as causing great injury to peaches and plums respectively, but they can be kept in check by a lime-sulphur wash containing lead arsenate. V. L. Wildermuth writes on the clover-root curculio (*Sitones hispidulus*), which injures clover, although it is probably not a common pest. It is eaten by a number of birds, and, in the larval stage, is attacked by a fungus. W. M. Russell describes a cigar-case bearer (*Coleophora caryaefoliella*) attacking pecari trees; it is not yet abundant, and can probably be kept in check by lead arsenate washes. H. O. Marsh deals with the common Colorado ant (*Formica cinereorufibarbis*), which has fallen under the ban because it protects the melon aphis. It is said to be a common thing to see the ants busily engaged in killing and carrying off the syrphid larvæ which were destroying the aphides. Adults of a lady-bird, *Hippodamia convergens*, the nabid bug, *Reduviolus ferus*, and a species of Chrysopa were also carried away by the ants. The simplest method of extermination seemed to be watering the nests with a weak solution of potassium cyanide.

Not only at the Department of Agriculture, but also at the colleges, are investigations undertaken, and a large number of bulletins are issued. Many of these make no claim to originality, and are mainly of interest to us as showing how the American colleges try to educate the farmers. These bulletins are always well illustrated, pictures being given of typical infested plants and of the pest in its various stages, so that recognition shall be easy. Preventive and curative methods are described where known, and farmers are told where they may apply for further information. Admirable bulletins of this class are sent out by the agricultural experiment stations of the West Virginia University, the Purdue University, the Colorado Agricultural College, and others.

Turning to the British Dominions, good work is being done in India, and is published in the Pusa Memoirs and *The Agricultural Journal of India*. The Transvaal work appears in *The Transvaal Agricultural Journal*. In a recent issue of *The Agricultural Journal of the Cape of Good Hope*, Messrs. Laws and Manning discuss the eradication of ticks on the veld. Of the three methods in vogue, periodical dipping or spraying of the hosts, grass burning, and the enclosing of definite areas for a sufficient length of time to ensure all ticks dying off through the absence of hosts, they consider the dipping or spraying the best, but the other two are also effective. In another article the ostrich wire-worm (*Strongylus douglassii*), a worm found in the proventriculus of the ostrich, is described; the treatment commonly adopted is to give a strong dose of carbolic acid, insufficient, of course, to kill the bird. It is not considered, however, that this treatment is satisfactory, and others are discussed, but none can be depended upon as certain.

The scientific work of the entomological staff of the

West Indies appears in the West Indian Bulletin, and the more technical work in *The Agricultural News*. Mr. F. W. South deals in a recent issue of the Bulletin with the control of scale insects by means of fungoid parasites. The fungi can be introduced in two ways: material containing fructifications may be hung on the tree near to the scale-infested part, or the fructifications may be stirred up with water, which is then sprayed on to the tree. When the spores germinate, the hyphæ grow under the scales and destroy the insects. In every issue of *The Agricultural News* a section is devoted to insect and fungoid pests; the diseases of rubber trees have recently received considerable attention. Some of the islands, as Jamaica and Trinidad, issue their own bulletins, in which the staff publications appear. In the Trinidad bulletin Mr. Rorer deals with pod-rot, canker, and chupon-wilt of cacao in a well-illustrated paper; spraying is shown to be effective, but definite instructions cannot yet be given owing to the absence of local experience of the treatment.

The Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, contain accounts, by T. Petch, of root diseases of Hevea and of *Acacia decurrens*, which is extensively planted as a wind-break in tea plantations and also for green manuring. The brown root disease, caused by *Hymenochaete noxia*, is the commonest root disease of Hevea in Ceylon, although this fungus does less damage than *Fomes semitostus*. *Sphaerostilbe repens* is also recorded, but is as yet not common. Two diseases of Acacia are described, one caused by an agaric, *Armillaria fuscipes*, the other by *Fomes australis*. A remarkable plague of a large snail, *Achatina fulica*, is described by E. E. Green, which swarms in millions in one area of the island. On the whole, it is considered to do more good than harm, as it feeds on animal and human excrement, and does comparatively little damage to the vegetation. Besides the circulars and journal, a series of leaflets are sent out from Ceylon.

Much of the Japanese work is published in the Journal of the College of Agriculture, Tokio, a beautifully illustrated periodical brought out in English and German. Vol. ii., No. 4, contains a paper by Ichiro Miyake on the fungi attacking rice. The list is, the author believes, complete, and as full references and descriptions are given, it must prove extremely valuable to other workers. It is in the true scientific spirit that the Japanese have broken down the barrier of language and issued their scientific publications in languages that can be read in the West.

In addition to the work going on at some of the larger agricultural colleges and departments in Great Britain, the smaller colleges are also studying the pests and diseases that occur in their districts. Mr. G. T. Malthouse recently, in a bulletin issued by the Harper-Adams Agricultural College, dealt with the wart disease of potatoes (*Chrysophlyctis endobiotica*), which has been doing much damage in Shropshire and Staffordshire. Accounts of the various diseases are also circulated as leaflets by the Board of Agriculture, as well as in their Journal.

TECHNICAL INSTRUCTION AND SECONDARY SCHOOLS.[1]

TECHNICAL instruction, in particular, has too long been looked upon as having little relation to the elementary or secondary schools. The schoolmaster has perhaps been too apt to view the technical school or college as an upstart and an interloper, the title of which to the name of an educational institution rests on a very insecure foundation, and the utilitarianism of which gives a somewhat unfair advantage in the competition for students. On the other hand, those engaged in technical work have in some cases looked upon the schoolmaster as an unpractical person, from whose clutches the student should be rescued at the earliest possible moment.

We have, however, now emerged from this stage, and are ready to discuss the relationships of our various schools with a better knowledge of the necessities and limitations of each, and taking as the basis the requirements of the scholar and not the supposed benefit to the school.

[1] An address read to the Annual Congress of the Secondary Schools Association, held at Bradford on February 24, by Prof. Walter M. Gardner.

The scholar's work, from entering the elementary school to the end of his studentship, whenever that may be, should appear to him as an unbroken progress, during which he can see gradually unfolding a definite scheme leading eventually to his life's career. In so far as the various grades of education form a series of detached schemes without proper interrelationship, and to the extent to which the student's time is wasted when he passes from one grade to another by reason of this, to that degree our educational administration is defective, and we, as administrators, are lacking in skill or in our duty to the students and to the public. The solution of this problem proves to be very difficult, and even now the matter hardly receives the attention which it deserves. To provide in a sufficiently economical manner courses throughout the school suited to the different needs and capacities of various scholars is *the* educational problem. At what stage to introduce differentiation, and when to begin specialisation, and at what age a scholar should pass from one school to another—these are important but minor matters incidental to the main problem.

Keeping to the front the thought of the ultimate benefit of the student, and making this the determining factor, many details will settle themselves. Difficulties, of course, at once arise, due to the uncertainty or to differences of opinion as to whether a particular course of action is or is not for the benefit of the scholar. Here ideals will probably at once clash with practicabilities, and, as the head of a technical institution, I am perhaps predisposed to lay stress on the latter.

The problem presents itself to me in this form:—"How can we make the best use of the student's time up to the age when experience shows he will, in all probability, leave school, and what portion of this should be allocated to technical instruction?" Others may state it thus:—"In order to acquire a thoroughly trained intellect and well-stored mind, a student should pass from the elementary school at twelve or thirteen years of age to the secondary school, and should remain at the latter for at least four or five years. He cannot, therefore, enter a technical school under the age of seventeen or eighteen." How are we to reconcile these views?

Whilst it is, of course, true that all of us, men and women alike, and whatever our avocation, are of greater service, are more efficient, if we have received some training which may legitimately be termed "technical," we are not concerned with this general aspect of the subject on this occasion, but with that specialised technical instruction provided in the technical institutions. The students we wish to get in such institutions are those who will pass into the great industries of the country; and in investigating this matter we are at once confronted with the fundamental point that, of a thousand boys who pass through the elementary schools and who ultimately take positions as workmen, foremen, or managers in industrial concerns, probably not more than forty pass through a secondary school, and not more than three or four enter a day technical college. There is, therefore, a problem of enormous magnitude still requiring solution relative to the further instruction of the 950 out of every thousand boys who do not proceed beyond the elementary schools.

Before the advent of steam-driven machinery, when industrial conditions were much simpler, the personal instructions which the boys received under the apprenticeship system sufficed to produce the necessary skill and training, though in a very unequal degree. The personal association of the craftsmaster and the learner cannot, however, be relied upon under modern industrial conditions, and therefore the technical schools are called upon to provide a substitute for the apprenticeship system. Boys leaving the elementary schools are not, however, sufficiently mature to reap the full benefit of the advanced specialised instruction provided in day technical schools, and for these boys, most of whom will eventually become industrial operatives, I strongly advocate the establishment of what are known as trade preparatory schools, with a two years' course comprising, roughly, two-thirds general subjects and one-third handicraft work. The majority of the boys should then go to work and attend evening technical courses, but those who show special promise should be drafted into the day courses of the technical school by means of scholarships. A necessary and

important link is thus formed between the elementary schools and the technical institutions, which link cannot be so efficiently provided by the evening continuation schools.

Such trade preparatory schools in no way interfere with the secondary schools. They simply provide for the further education of those boys who would not, in any event, go forward to the secondary schools. It is, however, obvious that the secondary schools must constitute the main feeder of the higher day technical courses, and it is this aspect of the general question with which we are chiefly concerned this afternoon.

With regard to the relationship between the secondary and technical schools, difficult and thorny questions at once crowd into the mind. At what age should the student pass from the secondary to the technical school? Should this age be the same, whatever the student's future career is likely to be? Should the secondary-school curriculum be the same for students who are going forward to a technical school as for those who are going into commerce or into one of the professions? If not, when should differentiation begin? Should any definite technical training (using the expression in the narrow sense of special training for industrial life) be given in the secondary school?

To not one of these inquiries can a categorical reply be given.

I am not at the present moment at all concerned with Government regulations as to age or curricula, but, looking at the age question purely from the point of view of the student's benefit, one cannot lose sight of the fact that the age at which the student should finally complete his school career depends on the nature of his future occupation; and this fact, coupled with the different requirements of various groups of students, in my opinion points strongly to the desirability, wherever numbers render it practicable, of differentiation in the secondary schools.

This raises the important question as to whether different groups of subjects may be made to yield similar educational results. If this is not so, differentiation must lapse; but many will probably agree that a study of science may be made as useful in developing intellectual capacity and character as an exclusive study of the humanities, and that as liberal an education may be got from literature and science as from entire devotion to languages, living or dead.

While speaking on this matter, I should further like to urge that education and culture, in the truest sense, may be acquired during the study of the processes involved in the transformation of raw materials into useful articles, which is the special business of the technical schools. The fact that present-day factory conditions are not perhaps conducive to the development of culture does not necessarily imply that educational ideals are inherently impossible in a technical school, but, on the other hand, emphasises the necessity of their development.

I argue, therefore, that a student's education, in the strictest sense of the word, is continued during a properly organised technical course, and must entirely dissent from the view that technical instruction is purely utilitarian.

We now come to close quarters with the question of the previous training desirable for students who will enter a technical college after passing through a secondary school.

May I point out in this connection that the value of the training in many secondary schools—speaking now of the information gained rather than the intellectual training—varies greatly according to the students' future work? If a lad is going to be a clerk, it so happens that most of the ordinary school subjects are such as will eventually form his tools in his trade of clerking. Of course, for higher commercial work he requires special instruction, but up to a certain point he receives his technical training incidentally along with the ordinary school training.

In the case of students who will enter the industries this does not hold good to anything approaching the same degree, and if it is possible to place these students on an equality in this respect by modifying the secondary-school curriculum, the gain to the technical schools will be enormous.

What, then, are the possibilities in this direction? With regard to the specialised technical work, I think nothing can be done. The importance of technical instruction being given by men having an intimate knowledge of the particular branch of industry concerned cannot be overrated, and such men are not likely to be found on the staffs of secondary schools, where, in fact, they would be out of place.

Manufacturing operations, and the technical instruction dealing with them, are, however, based on scientific fact, and mainly upon physical, mechanical, and chemical science, and a knowledge of these underlying sciences should precede the technical study of materials and processes. Men highly qualified to teach these sciences are, moreover, normally found on the staffs of secondary schools, and the teaching of physics, mechanics and chemistry, and of mathematics and art, might well be carried much further than is usually the case if it is done by the right men in the right way.

This, in my opinion, is the direction for advance. What we really need in the technical colleges are students with as much sound scientific training as possible—students trained to think for themselves and with the work habit highly developed. By economising time, this would enable us to carry students further forward, to the ultimate benefit of the industries of the country.

The whole matter is one which requires sympathetic consideration from both sides, and only in this way can any real advance be made. The teachers in the secondary and technical schools should be brought closer together, should have a more intimate knowledge of each other's work, and wherever practicable, as in a large city, the curriculum of at least one of the secondary schools should be so arranged as to offer to industrial students the same advantages as are now given in such generous measure to those who are training for commercial life or for the teaching and other professions.

CRYSTALLINE STRUCTURE, MINERAL, CHEMICAL, AND LIQUID.[1]

THE importance of crystallography has been growing so rapidly during recent years that the subject is no longer to be regarded merely as a branch of geology and mineralogy, but has now become a wide and far-reaching subject on its own account, embracing its former parent mineralogy, almost the whole of solid optics, the structure and physical properties, both mechanical and thermal, of solid matter, the structure and character of metals, with most important reference to their preparation for industrial application, and the fundamental groundwork of chemistry. Such a subject can no longer with impunity be relegated to a subsidiary part of a course in geology and mineralogy, but must in future be treated, studied, and taught as a specific branch of natural science. It is of the utmost urgency that all students of chemistry, physics, mineralogy, and metallurgy should be made acquainted with the main facts of the science in order that they may understand their own subjects with clear and broad insight.

It is a remarkable fact that no definition of life has yet been given which will not include a crystal. The virility and longevity of seeds and spores are often found to be quite extraordinary; but the power of crystalline growth goes even further, for it is everlasting. An instance was taken in the first lecture from common sand grains, which, originally quartz crystals in a granitic rock, after passing through every variety of vicissitude for thousands of years, when eventually they come in contact with water containing a little of their substance, silica, in solution, begin to grow again as crystals of quartz. A slide of such sand grains was shown on the screen, having perfect little quartz prisms and pyramids growing out from them.

Some fine examples of the growth of crystals were projected on the screen in polarised and ordinary light, notably of benzoic acid crystallising from the melted condition, of white arsenic crystals growing from the vaporous state, and of potassium bichromate and ammonium chloride growing from solutions of different degrees of supersaturation. Especial emphasis was laid on the fact that slow growth from the slightly supersaturated condition, that which has been so clearly defined

[1] Summary of three lectures delivered at the Royal Institution on February 28, March 7, and March 14, by Dr. A. E. H. Tutton, F.R.S.

by Miers and Ostwald as the "metastable" condition, usually yields well-formed individual crystals suitable for study and measurement, whereas crystallisations from more strongly supersaturated solutions, those in the "labile" condition, invariably take the character of skeletal, tree-like, or acicular forms, very beautiful, but unsuitable for crystal measurement. The extraordinary fact was then referred to that germ-crystals of all common crystalline substances are constantly floating about in the air, and that by falling into metastable solutions of their own or similarly constituted (isomorphous) substances are able to set them crystallising. Indeed, metastable solutions are entirely dependent on such intrusions of germ-crystals, for labile solutions are alone capable of spontaneous crystallisation.

The great diversity of habit of the crystals of the same substance was next discussed, and a striking instance given in the three common forms of calcite, carbonate of lime, namely, the rhombs of Iceland spar, the scalenohedral (pyramidal) dog-tooth spar, and the long prismatic form of calcspar terminated by rhombohedra. Totally dissimilar specimens of all three were exhibited, and others still more remarkable, from the same mine, were projected on the screen, so unlike as to be apparently the crystals of quite different substances. Yet the faces present were geometrically the same, but developed to different extents, in all three, and inclined at angles of precisely the same value. It was shown how this diversity of habit had delayed the discovery of the laws of crystallography, and the historic sequence of events, from the seventeenth century onwards, was briefly outlined, until in 1784 the main laws were enunciated by the Abbe Haüy, especially the great law of the constancy of the angles of the crystals of the same substance.

The natural classification of crystals into seven styles of architecture or crystal systems, according to the geometrical disposition of their faces, was then discussed, and shown to depend on the presence of a greater or less number of planes and axes of symmetry, this external configuration being due to the regular homogeneous character of the internal structure. It was shown that this latter is of the nature of a space-lattice, each unit cell of which is occupied by a chemical molecule. The chemical molecules are thus the regularly arranged bricks of the crystal edifice. Some remarkable examples of crystals of the various seven systems were exhibited, both in the form of natural mineral crystals of large size, and of artificial crystals, some of considerable size and others grown under the microscope, photographs of many such crystals taken in the act of growth being exhibited on the screen.

The grouping of crystal faces in "forms" or sets having an equal value with respect to the symmetry, and the mode of distinguishing the faces by their "indices," symbols of three or four figures (inversely proportional to the lengths of the axes cut off by the face) enclosed within brackets, was explained. The simple or "rational" nature of these indices, the low numbers, 1, 2, 3, and 4 vastly predominating, and being often the only numbers involved, was emphasised, thus demonstrating the important law of rational indices.

It was shown in the second lecture that these external regularities are entirely the consequence of the internal homogeneity and structural symmetry of the molecular arrangement in one or other of the fourteen space-lattices referred to in the first lecture. The remarkable work of Sohncke, Schönflies, von Fedorow, and Barlow was then discussed, whose joint labours had indicated 230 types of homogeneous structure, represented by point-systems, and which include 165 involving the property of mirror-image symmetry and 65 Sohnckian assemblages of points which do not, but clusters of which latter, if each cluster be represented by a single point, give us the 14 space-lattices. The interesting fact was brought out that the space-lattice represents, in all the simpler cases, the arrangement of the molecules, while the detailed point-system represents the plan of distribution of the atoms.

It was also shown how recent work had confirmed the law of Haüy as to the constancy and specific nature of the crystal angles of any one substance, and that in the cases of the isomorphous series of Mitscherlich, composed of analogously constituted compounds, which were at first supposed to be identical in their crystal morphology, the crystals of the different members of the series show small but real differences in their angles, and even greater differences in their other properties. Moreover, the differences conform to a definite law, for they follow the order of progression of the atomic weights of the interchangeable chemical elements which give rise to the series. The dimensions of the structural-unit molecular cells of the space-lattice also conform to this law.

The optical properties of crystals may, in general, be represented by an ellipsoid, the three rectangular axes of which are proportional to the three different refractive indices afforded along those directions, and the position of which varies with the symmetry. Crystals of the rhombic, monoclinic, and triclinic systems have such a triaxial ellipsoid, but it becomes an ellipsoid of revolution for crystals of the tetragonal, hexagonal, and trigonal systems, and a sphere for a cubic crystal. This property thus at once enables us to discriminate between these three groups of crystal systems, which are characterised, respectively, by three indices, two indices, and one index of refraction. The directions of the three axes of the ellipsoid are identical with the crystallographic ones in a rhombic crystal, but only one axis is coincident with a crystal-axis in a monoclinic crystal, and no axes are coincident in a triclinic crystal.

Such an ellipsoid with three unequal rectangular axes must possess two circular sections symmetrically situated, and directions perpendicular to these sections are the well-known optic axes of "biaxial" crystals, more or less comparable to the single axis of no double refraction of "uniaxial" crystals, which are characterised by an ellipsoid of revolution. It is round these two optic axial directions that the well-known spectrum-coloured rings and dark hyperbolic "brushes" are visible in convergent polarised light, thus forming the biaxial analogue of the circular spectrum-rings and black rectangular cross of a uniaxial crystal such as calcite. Many of these phenomena were projected on the screen with the projection polariscope, including the Mitscherlich experiment showing the crossing of the optic axial plane of gypsum as the crystal becomes warmed by the heat rays accompanying the beam of convergent light.

The concluding lecture opened with a description of the remarkable "liquid crystals" discovered by Lehmann, substances of complicated and elongated chain-like chemical constitution, the molecules of which set themselves, by virtue of their inherent directive force, in shapes resembling crystals, which display double refraction and rotate the plane of polarisation. Mobile crystals of para-azoxyanisol in the form of rotating drops, of the ethyl ester of para-azoxy-benzoic acid, and of para-azoxy-phenetol in the shape of rounded crystals showing interference bands, were exhibited on the screen with the Zeiss projection microscope, and also spherulites of cholesteryl acetate, beautiful star-like apparitions breaking out all over the field, exhibiting colours and a dark cross in polarised light. The mobile crystals were instantly deformed on touching the cover-glass, but as instantly recovered their shape on removing the pressure.

The conclusion arrived at from experiments of this nature was that the molecular directive force of crystallisation, temporarily discarded as unnecessary by the geometricians for the building up of homogeneous structures, is reinstated as a fact which cannot be ignored. There can be no doubt that in these mobile crystals the chemical molecules are constantly arranging themselves in space-lattices, although the substance may be as mobile as water. The fundamental importance of the space-lattice, its formation by the chemical molecules as its structural units, and its influence in determining the crystal system, are thus again strongly emphasised.

It was proved by various optical devices that crystals of quartz exhibiting characteristic little facets on certain right-hand solid angles invariably rotate the plane of polarisation to the right, while other crystals on which these faces are only developed on the left-hand solid angles rotate the polarised rays to the left. It was further proved that this was due to an oppositely right-handed and left-handed helical arrangement of the atoms composing the molecules in the two cases, and that there are equal chances in nature for the formation of either. The re-

markable optical effects of the twinning of right- and left-handed quartz were also demonstrated, culminating in the interesting case of lamination twinning of amethyst; and interesting conclusions were drawn as to the chemical nature of the racemic, pseudo-racemic, and truly inactive varieties of substances showing the optically active forms.

It was made clear during these lectures how important crystallography is to chemistry. This importance has, however, been yet further enhanced by the recent work of Pope and Barlow, who have shown that the fundamental chemical property of valency is intimately connected with crystalline structure; for if we assume, as there is ground for doing, that the atoms present in a crystal may be represented by their spheres of influence arranged in contact, according to the particular type of homogeneous structure displayed, then the volumes of these spheres of influence are proportional in any one compound to the fundamental chemical valency of the atoms. This theory, when taken in conjunction with the lecturer's work on isomorphous series, in which the progression of the crystal properties was shown to follow that of the atomic weights of the interchangeable elements of the same family group forming the series, embraces the whole field of chemistry, the theory of Pope and Barlow relating to the horizontal progression and the generalisation concerning isomorphous series corresponding to the vertical progression of the periodic law of Mendeléeff. The importance of crystallography to chemistry is thus not only paramount, but fundamental.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced that Miss Mary Anne Ewart, who died on February 19, left 20,000*l.* to Newnham College, Cambridge, for scholarships for the benefit of women students studying there, and 10,000*l.* to Somerville College, Oxford, for like purposes.

A SHORT time ago announcement was made that the late M. A. Loutreuil had left the sum of 284,000*l.* for the promotion of science in France. Of this amount, 100,000*l.* was bequeathed to the University of Paris upon condition that the provincial universities also should benefit by the annual revenue derived from this sum. A message from Paris, published in *The Times* of March 29, states that a committee consisting of the Vice-Rector of the Sorbonne and a representative of the faculty of science of each of the provincial universities will decide the distribution of the revenue from the legacy, and will communicate its decisions to the council of the University of Paris. According to the terms of the will, the revenue of the gift is to be devoted to the encouragement of scientific studies, the equipment of laboratories, the formation of a library, and the foundation of additional lectureships on scientific subjects.

THE president's address to the members of the Institution of Mechanical Engineers was delivered on March 16. Mr. Ellington considered questions relating to the qualifications for membership; the Institution of Civil Engineers has already attained to a position such that it is difficult for civil engineers who are outside that body to obtain positions of responsibility. That the Institution of Mechanical Engineers is the proper body to secure the same standing for mechanical engineers is undoubted. Mr. Ellington insists on knowledge and experience in both theory and practice of mechanical engineering as essentials for admission, and would favour examinations for entrance to the grade of associate member. The council of the institution has always closely scrutinised the educational training and practical experience of candidates for membership, and properly conducted examinations would provide a desirable standard of entrance into the profession.

THE sum of 1400*l.*, says *Science*, has been received by the University of Michigan from the estate of Emma J. Cole, of Grand Rapids, Michigan, to constitute a scholarship fund for graduate students in botany. From the same source we learn that the regents of the University of Wisconsin have accepted as a trust the sum of 6060*l.* for the establishment and maintenance of a chair to be known as the Carl Schurz memorial professorship. The chair is to be filled by professors from the universities of Germany. The present fund will make it possible to secure a German professor for one semester every second year. President Van Hise has been authorised to open negotiations with German authorities with the view of establishing a system of exchange professors between German universities and the University of Wisconsin. The establishment of the Carl Schurz professorship will be celebrated on March 31. The speakers on that occasion will include the two German exchange professors now in the States, Dr. Max Friedlaender, of the University of Berlin, now at Harvard, and Prof. Ernst Daenell, of the University of Kiel, Kaiser Wilhelm professor at Columbia.

THE trustees of the A.K. Travelling Fellowships will shortly elect two fellows. These fellowships, for which both men and women are eligible, are each of the value of 660*l.*, are awarded annually, and, as has been explained in these columns, were established for the purpose of enabling the fellows to travel round the world. The trust is administered at the University of London. The appointments are made by a board of trustees, and candidates are nominated by the Vice-Chancellors of each of the universities of the United Kingdom, the president of the Royal Society, and the president of the British Academy, but the trustees are not required to confine their election to these nominees. The only conditions for candidature are that candidates shall be British subjects and graduates of, or persons who have passed all the examinations required for a degree in, some university of the United Kingdom. An incorrect impression exists that persons to be nominated as candidates must be members of the teaching profession in one of its grades. The founder's object in establishing the fellowships is in no sense to further any special line of research, but to enable intellectual men to enter into personal contact with men and countries they might never have known. The English fellowships are part of a general scheme for the establishment of similar foundations in various countries, and endowments have been made already for this purpose in France, Germany, Japan, and the United States.

THE third annual report of the governing body of the Imperial College of Science and Technology deals with the work for the year ending July 31, 1910, and shows that the activities of the college were much extended during that period. The building extensions were pushed forward, and some are now nearly complete. The workshops of the City and Guilds College have been extended, at a cost of 8000*l.* to the City Guilds Institute, to provide for the development of the course of instruction in railway engineering commenced two years ago. We notice that the Bessemer memorial committee has decided to provide 10,000*l.* to assist in equipping the mining and metallurgical laboratories, and the laboratory so furnished will be called the Bessemer Laboratory, and in it a statue of the late Sir Henry Bessemer will be erected. The governing body has secured the services of leading men of large experience in connection with great industrial concerns of the country, or of men with special knowledge, for the purpose of giving short courses of advanced lectures on such branches of science as press for immediate study. Financial considerations prevented the full and immediate realisation of the department of chemical technology recommended by the Advisory Board concerned with this subject, but a beginning has been made, so far as is practicable, in the existing buildings. Great attention has been given by the governing body to the provision of facilities for the study of the relation of the biological sciences to the industries, and funds have been set aside for the foundation of a chair of plant physiology and pathology, and it is hoped that resources will be forthcoming for its permanent endowment. A complete scheme of scientific instruction and research in aëronautics has been drawn up, and much work has been done in providing facilities for such study. The approved budget for 1910–11 for the Imperial College as a whole estimates a revenue of 59,006*l.*, and an expenditure of 67,374*l.*—a deficit of 8368*l.*, while the estimated effect of capital commitments (buildings, &c.) will be to reduce the unappropriated capital to 100,935*l.*

IN the issue of *Science* for March 10, Prof. Rudolf Tombo, jun., deals with the statistics of students at

German universities. His article on the registration statistics of American universities, to which reference was made in these columns on March 23 (vol. lxxxvi., p. 133), leads to certain interesting comparisons. The twenty-one German universities show an enrolment for the winter semester of 1910–11 of 54,822 students, as against 52,407 students the winter before. During the past five years there has been an increase in registration of no fewer than 12,432 students. The number of women students has grown from 211 five years ago to 2418 in the present session. The number of students studying pure science is 7914 as compared with 7349 in the previous session, in agriculture 2546 as compared with 2085, and forestry 171 as compared with 129. The three largest universities —Berlin, München, and Leipzig—alone enrolled no fewer than 39 per cent. of the total German student body. Berlin remains at the top with an enrolment of 9686 students, as against 9242 last winter. This is followed by the University of München with 6905 students (6537 last year). It will be remembered that for the first time in the history of American universities the 7000 mark was passed in the last winter session, Columbia having a grand total of 7411 students. Six American universities have now more than 5000 students. In Germany, Leipzig is the third most numerously attended university, and has 4900 students. Bonn follows with 3846. Seven others have fewer than 3000 and more than 2000 students, and all but two—Greifswald and Rostock—have more than 1000 students. The figures show that all the universities, with the exception of Erlangen, Würzburg, and Giessen, have increased their attendance, the largest gains having been made by Halle, Kiel, Jena, Tübingen, and Rostock. Since 1909–10 Breslau has been passed by Halle, Göttingen by Freiburg, Heidelberg by Münster, Würzburg and Königsberg by Kiel. In addition to the 54,822 matriculated students, 3528 men and 1772 women are enrolled as auditors, giving a total of 60,122 individuals receiving instruction at the German universities, the largest number in the history of German higher education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 23.—Sir Archibald Geikie, K.C.B., president, in the chair.—G. N. **Watson**: A theory of asymptotic series.—R. T. **Beatty**: The ionisation of heavy gases by X-rays.—W. **Wilson**: The variation of the ionisation with velocity for the β particles. Rays of different speeds were separated, by means of a magnetic field, from the heterogeneous beam given out by the active deposit from radium. The relative numbers of particles corresponding to the different speeds were determined by measuring the charges gained per second by an insulated copper vessel which was placed in the path of the rays, and was thick enough to absorb them completely. The corresponding ionisations were determined by a separate experiment, and were corrected for scattering of the rays by the walls of the ionisation vessel. The results obtained are as follows:—(1) The ionisation produced per cm. by β particles in free air varies inversely as the square of the velocity, between the limits examined. (2) The ionisation in a thick copper vessel is not connected with the velocity by any simple law, but can be approximately represented by $I=k(c-v)$, where I is the ionisation, v the velocity of the particles, and k and c constants.—C. G. **Douglas** and Dr. J. S. **Haldane**: The causes of absorption of oxygen by the lungs in man.—Prof. Arthur **Schuster**: The influence of planets on the formation of sun-spots. In this investigation the relative position in heliocentric longitude of a planet, and that point of the sun's disc where a spot is first observed, is taken as starting point. Spots first noticed within 60° of the eastern limb were excluded on account of the possibility or probability that these spots were formed in the invisible hemisphere, and only brought into view by the rotation. The total number of spots taken into account was about 4250. Imagine an observer placed on the sun. He might observe within each solar rotation, imagined to be divided into twenty-four hours, a planet rising, reaching a maximum altitude, called "planetary noon," descending and setting. The chief results of the investigation, dealing with the planets Mercury, Venus, and Jupiter, are as follows:—(1) More spots are formed when the planet is above the horizon than during the planetary night. The excess amounts to 4·5 per cent. in the case of Mercury, 6·4 per cent. in the case of Venus, and 1·5 per cent. in the case of Jupiter. The probability that this excess is accidental in the case of Mercury and Venus is about 1 in 7 and 1 in 17 respectively. In the case of Jupiter, the difference is no more than might be expected by the theory of chance. Not much importance is attached to each of these results taken separately, but if the theory of probability be applied to the combined results, an accidental coincidence of the excesses of one hemisphere over the other to the amounts indicated will not happen more than once in 1150 cases. (2) More decided results are obtained if the formation of spots during different parts of the planetary day are investigated. If the distribution were purely accidental, twice as many spots should form during the eight hours after the planet has risen as in the four hours before it sets. It is found, on the contrary, that during the latter interval the number of spots bears a proportion of 0·344, 0·349, and 0·347 respectively to the whole instead of 0·333, the planets always being taken in order of distance from the sun. The average excess here amounts to about 5 per cent. (3) The effect of the planets when compared in detail exhibits remarkable similarities. At an observing station on the sun, a strong minimum of spot formation is found to exist shortly before the planet rises; this is followed by a decided maximum in all three cases one hour after the rise. This is succeeded by a drop in activity, leading to a minimum, which occurs sooner with Mercury and Venus than with Jupiter, but this distinction may be accidental. The most remarkable feature in all three cases is the rapid rise from a secondary minimum, one hour after the planetary noon, to a pronounced maximum two hours later. This is followed by a drop lasting until the hour before the planet sets. The action after that and during the greater part of the planetary night is irregular, and might disappear if a larger quantity of material were available. The probability that all three planets should show their greatest activity at the same hour to the extent shown by the figures is 1 part in 130 million. The probability of the corresponding minimum in the planetary morning is not much less, so that taking the coincidence of both these factors into account, we may exclude the possibility of an accidental coincidence.

Royal Astronomical Society, March 10.—Mr. F. W. Dyson, F.R.S., president, in the chair.—Mr. Stratton gave an account of a paper by the late Mr. Bryan **Cookson**, a research on the aberration constant and the variation of latitude by means of the floating zenith telescope. The paper was left unfinished owing to the illness and death of the author, and had been completed and prepared for publication by Messrs. Hinks and Stratton. Their principal work had been to renew the search for systematic errors, and to prepare for press an account of the investigation. Sir David Gill spoke of the value of the constant of aberration obtained by Mr. Cookson. In reference to unexplained discordances, he suggested the possibility of a displacement of the zenith from meteorological causes.—Mr. Eddington gave a short account of a paper by Dr. W. **de Sitter** on the bearing of the principle of relativity in gravitational astronomy. It was assumed that mass or inertia had an electrical origin, and it had been shown that the motion of matter relatively to the æther is impossible, the author being of opinion that the æther hypothesis might be abandoned.—Mr. **Davidson** showed photographs of Jupiter's satellite VIII., taken at the Helwân Observatory, Egypt, when the planet was too far south for observation at Greenwich. There was a certain residual when compared with theory which might disappear if we assumed a small error in the tabular orbit. —Prof. **Turner** read a paper on the determination of the positions of reference stars and fundamental stars by photographic processes. He compared the superseding of visual by photographic observations to the substitution of the telescope for the old "sight" instruments, which Hevelius and Halley considered the most accurate. Sir David Gill pointed out difficulties and recommended caution, and the Astronomer Royal considered that photography could not render observations with the transit instrument unnecessary, though moving wires might be

superseded by photographic methods.—Mr. Reynolds showed photographs of Halley's comet taken by Mr. **Knox Shaw** at the Helwân Observatory, and pointed out that when the comet was near the sun the tail seemed formed from the envelopes round the nucleus, leaving a dark streak in the centre. When farther from the sun the dark streak was replaced by a bright one, the tail appearing to spring from the nucleus itself.

Linnean Society, March 16.—Dr. D. H. Scott, F.R.S., president, in the chair.—Mrs. D. H. **Scott**: New species of the fossil genus Traquairia.—R. S. **Adamson**: An ecological study of a Cambridgeshire woodland.

CAMBRIDGE.

Philosophical Society, March 13.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Sir J. J. **Thomson**: Exhibition of photographs of Kanal Strahlen.—F. E. E. **Lamplough**: (1) Freezing point and depression of freezing point of sodium chloride. The depressions of freezing points of certain fused salts were measured by the platinum resistance thermometer. In the case of sodium chloride, the molecular depressions of the freezing point for most salts examined were nearly the same; that of sodium bromide, however, was half as great as the depression generally expected. In the case of calcium chloride as solvent, no regular results were obtained. Some unsuccessful attempts to measure directly the rate of migration of a coloured ion in fused silver nitrate, which led to the above research, were described. (2) A simple form of electric resistance furnace. A resistance furnace which may be easily set up, and is useful for many operations, such as the determination of freezing points, points of recalescence, and for slow cooling, annealing, &c., was described.—J. A. **Crowther**: Some experiments on scattered Röntgen radiation. Experiments have been made to investigate further the unsymmetrical distribution of scattered radiation already described by the author. The distribution has been shown to be unaffected by strong electric and magnetic fields. Experiments made near the primary beam have failed to detect any direct diffusion or irregular refraction of the primary beam itself.—H. E. **Watson**: Regularities in the spectrum of neon. The spectrum of neon, as previously measured by the author, has been examined with the view of finding some connection between the wave-lengths of the lines composing it. The existence of a number of triplets and quadruplets with constant oscillation frequency differences has been discovered, these being such that if A is the oscillation frequency of the first line, those of the other members are approximately $A+1070$, $A+1429$, and $A+1847$. In the case of the triplets, the second line is absent. These regularities apply only to the brightest lines of the spectrum, which fall naturally into three groups of diminishing intensity. The first group contains two very bright lines, three quadruplets, and three triplets; the second, two very bright lines, three quadruplets, and four triplets; and the third, two bright lines, three quadruplets, and five or six triplets. This type of regularity is not like that of helium, but is very similar to that part of the argon spectrum investigated by Rydberg. The investigation of the other lines is being continued.—J. C. **Chapman**: Fatigue and persistence effects in the production of secondary Röntgen rays. In these experiments a radiator was fully excited by X-rays, and its power of emitting secondary radiation was compared by a method only allowing 1/600th second for recovery from any fatigue which might exist, with that of a radiator of the same material not previously excited. The results with zinc, copper, and aluminium fail to show that any such fatigue is present. In addition, there is no measurable persistence in the production of secondary radiation from aluminium 1/8500th second after the removal of the exciting beam.—J. E. **Purvis**: The absorption spectra of the vapours of some sulphur compounds. The substances examined were diethyl trithiocarbonate, diethyl thionthiocarbonate, diethyl monothio-oxalate and dipropyl dithio-oxalate. It was found that (1) each of the vapours exhibited a large absorption band in the ultra-violet regions of the spectrum; (2) each band was comparable with the band found in the alcoholic solutions, except as regards position; (3) there was no series of narrow bands produced as a result of the freer vibrations; and (4) the general absorption was shifted towards the less refrangible regions as the temperature and pressure were increased. A discussion of these results from a consideration of the orientation of the atoms as a closed ring.—J. C. **Chapman** and E. D. **Guest**: The intensity of secondary homogeneous Röntgen radiation from compounds. The results of these experiments indicate that the same intensity of secondary homogeneous radiation is produced whether the metal which gives rise to it is combined or not, or whatever its compound.

PARIS.

Academy of Sciences, March 20.—M. Armand Gautier in the chair.—M. **Schloesing**, sen.: The mother liquors from the salt marshes. A study of the mother liquors in the salt works of Goulette, in Tunis.—E. L. **Bouvier**: The decapod Crustacea collected by the *Princesse Alice* during the voyage of 1910. For the bathypelagic fauna described, the modification of the Richard wire, due to M. Bourée, has been found to be of great service.—M. Hilbert was elected a correspondant for the section of geometry in the place of M. Dedekind, elected foreign associate.—Sigismond **Janiszewski**: Continuities irreducible between two points.—René **Garnier**: Differential equations with fixed critical points and hypergeometric functions of higher order.—G. **Reboul** and E. Grégoire **de Bollemont**: The transport of particles of certain metals under the action of heat. If a sheet of platinum is placed at a short distance from a sheet of copper, and both heated to about 800° C., a black deposit is seen to be formed on the platinum. This was proved to consist for the most part of copper oxide. The magnitude of the deposit under varying conditions has been studied.—Samuel **Lifchitz**: Displacement of particles in the Brownian movement with the aid of very rapid sound vibrations.—E. **Caudrelier**: Researches on the constitution of the electric spark. The initial state of ionisation of the gap in certain cases has an influence on the discharge of transformers, but the action is very complex. M. **Guilleminot**: The yield in secondary rays of X-rays of different quality.—A. and L. **Lumière** and A. **Seyewetz**: Differentiation by means of chemical development of the latent images obtained with emulsions of silver chloride and bromide. The special developer used contained sodium quinone-sulphonate and sodium sulphite in water. With this solution a latent image obtained in a gelatinochloride emulsion could be developed in some minutes, whilst no trace appeared in a gelatinobromide emulsion, even strongly over-exposed.—G. **Urbain** and C. **Scal**: Monovariant systems which admit of a gaseous phase.—Marcel **Dubard**: The genus Planchonella, its affinities and geographical distribution.—L. **Lindet**: The elective power of plant cells towards dextrose and levulose. Experiments on the behaviour of fungi towards dextrose and levulose confirm the results previously obtained with beetroot. Levulose is specially concerned with tissue formation, whilst dextrose is more decomposable and more easily split up by fermentation or burnt by respiration.—G. **André**: The conservation of saline materials in an annual plant; the distribution of the dry substance, total ash, and nitrogen.—M. **Marcille**: The mode of action of sulphur utilised for destroying oïdium. The author's experiments show that neither the volatilisation of sulphur nor its oxidation can be regarded as having any appreciable effect on the fungus. Sulphur appears to act upon oïdium solely by reason of the sulphuric acid which it contains ready formed.—M. **Mazé**: The influence of mineral substances which accumulate in the organs as assimilation residues upon the development of the plant. The absorption of colloidal organic materials by the roots.—Mme. Z. **Gruzewska**: Some characteristic properties of amylase and amylopectine.—M. **Tsvett**: A new plant colouring matter, thuyorhodine. The analysis of the winter pigment of Thuya has shown that there is no modification of the α and β chlorophyllines, but that there is a new red colouring matter formed, for which the name thuyorhodine is proposed. The method of extraction and properties of this substance are given in detail.—C. **Delezenne** and Mlle. S. **Ledert**: The action of cobra venom upon the serum of the horse. Its relations with hæmolysis. The experiments described lead to the conclusion that snake venom acts as a catalytic agent or a species of diastase capable of liberating at the expense of certain materials in the blood serum a substance endowed with true hæmolytic properties; this catalytic action is considerably limited

by the presence of blood corpuscles.—MM. **Doyon**, A. **Morel**, and A. **Policard**: Passage of the anti-coagulating nucleo-proteid of the liver into the blood. Comparative action of atropine according to the mode of penetration.—J. **Le Goff**: The mortality through diabetes in Paris and in the department of the Seine. In thirty years the number of deaths caused by diabetes has quadrupled. This may be due to a relative increase in the number of cases or to a higher rate of mortality per 1000 cases. The possible causes of this increase are discussed.—Jules **Courmont** and A. **Rochaix**: Immunisation through the intestine. Antityphoid vaccination. These researches were carried out on the goat, guinea-pig, rabbit, and on man. No inconvenience results to the human subject by the use of this method.—Mme. **Fabre** and A. **Zimmern** and G. **Fabre**: The action of a continuous current on the diadermic penetration of radio-active substances.—MM. **Haret, Danne,** and **Jaboin**: A new method for the introduction of radium into the tissues. The radium ions are introduced into the organism by the electrolysis of a solution of a pure radium salt.—L. **Bruntz** and L. **Spillmann**: The origin of cancers of the skin.—G. **Guilbert**: The storm of March 13, 1911.—A. **Baldit**: Observations on the electric charges of the rain in 1910 at Puy-en-Velay.

DIARY OF SOCIETIES.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—The Chemical Dynamics of Serum Reactions: Captain A. G. McKendrick.—Preliminary Note on a Method of Measuring Colour Sensations by Intermittent Light, with Description of an Unfinished Apparatus for the Purpose: Dr. G. J. Burch, F.R.S.—On Variation and Adaptation in Bacteria, illustrated by Observations upon Streptococci; with special reference to the Value of Fermentation Tests as applied to these Organisms: E. W. A. Walker.—On the Inter-relations of Genetic Factors: W. Bateson, F.R.S., and Prof. R. C. Punnett.—A Case of Gametic Coupling in Pisum: P. de Vilmorin and W. Bateson, F.R.S.—On Gametic Coupling and Repulsion in *Primula sinensis*: R. P. Gregory.

ROYAL INSTITUTION, at 3.—Surface Combustion and its Industrial Applications: Prof. W. A. Bone, F.R.S.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—Travelling at High Speeds on the Surface of the Earth and above it: Prof. H. S. Hele-Shaw, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: J. Swinburne, F.R.S.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, APRIL 3.

SOCIETY OF ENGINEERS, at 7.30.—The Administrative Aspect of Water Conservancy: W. R. Baldwin-Wiseman.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Measurement of High Temperatures: C. T. Heycock, F.R.S.—Gum from the Bombax Malabaricum: P. P. Phillips.

ARISTOTELIAN SOCIETY, at 8.—The Place of Psychology in Philosophy: Dr. Wm. Brown.

VICTORIA INSTITUTE, at 4.30.—Indications of a Scheme in the Universe: Rev. Canon Girdlestone.

TUESDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Explorations of Ancient Desert Sites in Central Asia: Dr. M. A. Stein.

ZOOLOGICAL SOCIETY, at 8.30.—Demonstration of Nematode Parasites obtained from Animals in the Gardens: Dr. R. T. Leiper.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. No. I. On some Mammalian Tapeworms: F. E. Beddard, F.R.S.—On the Natural History of Whalebone Whales: J. A. Mörch.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Improvement of Highways to meet Modern Conditions of Traffic: J. W. Smith.—Recent Development in Road-traffic, Road-construction and Maintenance: H. P. Maybury.

ROYAL SOCIETY OF ARTS, at 4.30.—The Commonwealth of Australia: Capt. R. Muirhead Collins.

WEDNESDAY, APRIL 5.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Analytical and Microscopical Examination of Compound Liquorice Powder: G. E. Scott-Smith and J. Evans.—(1) Note on Almond and Apricot Kernel Oils; (2) Constants of Chicken and Turkey Fats: Raymond Ross and J. Race.—(1) Note on Gerber's "Neusal" Milk Test; (2) Note on Abnormal Cotton Cakes: J. Golding.—A Further Contribution to the Question of Turpentine Substitutes: J. H. Coste and L. Myddelton Nash.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—The Problem of Size in Battleships: Prof. J. J. Welch.—Twelve Months' Experience with Geared Turbines in the Cargo Steamer *Vespasian*: Hon. C. A. Parsons and R. J. Walker.—The National Experimental Tank and its Equipment: G. S. Baker.

GEOLOGICAL SOCIETY, at 8.—Trilobites from the Paradoxides Beds of Comley (Shropshire), with Notes on some of the Associated Brachiopoda (by Dr. Charles Alfred Matley): E. S. Cobbold—The Stratigraphy and Tectonics of the Permian of Durham (Northern Area): Dr. D. Woolacott.

ROYAL SOCIETY OF ARTS, at 8.—Wheels, Ancient and Modern and their Manufacture: H. L. Heathcote.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: A Chemically-active Modification of Nitrogen produced by the Electric Discharge: Hon. R. J. Strutt, F.R.S.

ROYAL INSTITUTION, at 3.—Surface Combustion and its Industrial Applications: Prof. W. A. Bone, F.R.S.

LINNEAN SOCIETY, at 8.—On the Brown Seaweeds of the Salt Marsh: Miss S. M. Baker.—On the Genus Salicornia: Dr. C. E. Moss (History, Synonymy, and Phylogeny), E. J. Salisbury (Characters of the Species), and Dr. Ethel de Fraine (Anatomy).

RÖNTGEN SOCIETY (King's College), at 8.15.—Secondary Rays: Prof. Barkla.—An Improvement in High Tension Discharge Apparatus: Prof. Wilson.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—Diesel Engines for Sea-going Vessels: J. T. Milton.—The Influence of Longitudinal Distribution of Weight on the Bending Moments of Ships among Waves: F. H. Alexander.—Considerations affecting Local Strength Calculations of Ships: J. Montgomerie.—At 7.30: The Acceleration in Front of a Propeller: R. E. Froude.—An Investigation into the Stresses in a Screw Propeller Blade: Engineer-Lieutenant A. Turner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Wireless Telegraphy Working in Relation to Interferences and Perturbations: J. E. Taylor.

FRIDAY, APRIL 7.

ROYAL INSTITUTION, at 9.—A New Method of Chemical Analysis: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, APRIL 6, 1911.

ARTS AND INDUSTRIES IN THE ENCYCLOPAEDIA BRITANNICA.

Collection of Articles on Industries and Manufactures (loose sheets) from the New (Eleventh) Edition of the "Encyclopaedia Britannica." (Cambridge: University Press, n.d.)

THIS collection of technical articles from the *Encyclopaedia Britannica* must be taken as consisting of samples only, since it does not go beyond the first half of the alphabet—"Alkali Manufacture" to "Iron and Steel"—and even for that half it is certainly incomplete. There must be more than as many more articles which in any reasonable classification would be included in the category of technical. Hence even if the reviewer were endowed with a mind encyclopædic enough for the task, it would not be possible from the examples to criticise the work as a whole, to test it as it should be tested, by hunting up subjects with which the critic is familiar, and seeing how the work comes out of the trial. All that can be done is to take the specimens, and to form such opinion upon them as we may, minimising any deficiency in omniscience by the simple (and usual) expedient of dwelling on the familiar and ignoring the unknown. But, after all, the material is ample enough even if it be but a tenth of the whole—πλέον ἥμισυ πάντος—we really have got more than we want.

It would be too much to say that there is real uniformity in the method of treatment. Humanly that were impossible. But there is a much nearer approach to uniformity than in the older editions, so far as can be judged from the selected articles. Perhaps it would be more evident in other than the technical sections. In these there seems to have been a good deal of compression. On the whole, the articles, especially the longer articles, seem to be shorter than those in the ninth edition. Perhaps in some cases the material has been transferred to other headings. Often the historical part has disappeared, or been abbreviated. The modern articles seem more sternly practical than their predecessors. Sometimes this is a pity, and it makes one hope that not all the old series will be exchanged for the new version, and sent to be pulped. Perhaps now that we are all utilising the completed applications of science, it does not much matter how they have been developed, but to some misguided folk the history of invention is not the least interesting of the various branches of human history.

It is, of course, in the method of treatment that the various articles show a certain lack of uniformity. Some are too technical. The first on our list, "Alkali Manufacture," which seems quite new, though perhaps part of the information in it may have appeared under some other heading in the ninth edition, errs, to our mind, in this respect. It is an excellent and clearly written account of the manufacture in its modern forms, but it would be hardly intelligible to anybody who had no knowledge of chemistry. The allied articles "Bleaching" and "Dyeing," are quite different in character, and are better adapted for their immediate purpose. The expert does not need to apply for information about his own subject to an encyclopædia, and the writer of an article for an encyclopædia has no right to assume that his reader has even the small amount of technical knowledge required to make him understand the sort of article which to the expert might seem commonplace.

The article on "Electricity Supply" seems an admirable model for any writer to follow. It contains just the information which would be needed, say, for the owner of a country-house, who is thinking of installing the electric light, while it is also an admirably condensed and clear account of the latest development of the subject. "Electro-metallurgy" is good, but incomplete, no doubt because certain parts of the subjects are dealt with in articles such as "Electrochemistry," not included in our bundle.

Some of the articles are very interesting, because when compared with the corresponding articles in previous editions they show very clearly the progress of invention. Notable in this way, for instance, is "Bicycle." In 1875 the latest novelty was the old "Ordinary," really an extremely dangerous machine. The supplement had "cycling," but not "bicycle" (encyclopædia articles are wont to find themselves under the latest convenient letter of the alphabet), and now we have a very full and excellent account of the modern machine.

Other articles indicate that certain industries have changed but little in the past two and twenty years. Take "Clocks," for instance. The long and admirable treatise contributed by the late Lord Grimthorpe to the older edition has been rewritten and shortened by some three pages. If we omit the account of electrical clocks, there does not seem very much new matter in it, but a good deal appears to have been judiciously left out.

Perhaps the most important, as it is the longest, of our batch is the article on "Iron and Steel." It is much less than half the length of the corresponding article in the previous edition (some thirty-four pages as compared with eighty-four), by the late Dr. Alder Wright. The opinion may be expressed, though with considerable hesitation, since it could only be justified by a minute and careful comparison of the two articles, that on the whole the longer article of the ninth edition gave a better account of the state of the manufacture in 1881, the year of its publication, than the present one does of its condition in 1911. At the same time, it does give a full, and no doubt accurate account of recent advances, and perhaps most of what is omitted has become of little more than historical interest. As time goes on Bessemer and Mushet and Siemens must take their place with Cort and Darby and Dud Dudley, but it is early days yet for that. We should have thought that some account might have been given of the

application of the microscope to the study of metals, which, extensively applied by Roberts-Austen to the examination of alloys, has, in the hands of Rosenhain and others, so much increased our knowledge of the nature and structure of iron. Its results are fully utilised, and there are a couple of photomicrographs of iron, but the process is not described. If space were wanted, we might have spared the remarks on the evidence of design afforded by the abundance of iron, and the somewhat vague speculations as to how primitive man was led to the reduction and utilisation of the metal.

Of the three great divisions of the textile industries, only one is included in our purview. The linen and woollen trades must of necessity come later in their proper alphabetical place. Even hemp and jute belong to the second half of the list. Cotton alone comes into an early volume. It is the subject of three long and important articles, one dealing with the supply of the raw material and the trade, the second with the manufacture generally, and the third with cotton-spinning. The first of these seems very complete, and the information is brought well up to date, but the technology of the subject proper is dealt with only in the other two. The remark was made above that the history of trade and invention came in for less than its fair share of notice. This criticism certainly does not apply to the article on "Cotton Manufacture." No better summary of the history of this great industry need be desired. Doubtless it might be amplified, but that would carry it beyond reasonable limits. The author has availed himself of all the usual sources of information, and has also discovered others which are certainly not familiar to all students of the subject. It is indeed an admirable essay. The article on "Cotton-spinning Machinery" is good, but will have to be studied in connection with other articles—"Carding," "Spinning," "Weaving," &c., not included with those before us.

Another article dealing with a department of the textile industry is the one on "Carpet." This has been rewritten, and some inaccuracies in the previous edition have been set right. Alike from the historical and from the artistic point of view this is an excellent paper. As regards purely technical information it is deficient. The appended bibliography is very complete. If "Carpet" is not quite technical enough, "Damask" is nothing else, and is scarcely intelligible to a reader ignorant of weaving terms.

"Bookbinding" is a subject of such general interest that the editor might well have allotted more than five pages to it, or might have allowed his contributor the space now devoted to four large but quite unnecessary pictures of machinery. Within the narrow limits, the account of artistic binding is sufficient, but the description of machine binding is quite inadequate.

Turning now to the shorter articles, we find many which are models of what such work should be, crammed with information condensed into the smallest possible space. Potted knowledge, in fact, such as we may properly expect in an encyclopædia. Perhaps the editor found his minor contributors more amenable to his Procrustean rule than the self-willed experts upon whom he had to rely for special knowledge. Among such articles may be noted "Basket," "Fireworks," "Flax," and "Goldbeating," though many others might be mentioned.

A word of protest may be permitted about some of the illustrations. Where space is so valuable why devote whole pages to photographs of machines and factory rooms, which convey no valuable information whatever? For instance, there are four half-tone blocks, occupying two pages, which illustrate "Cotton-spinning" machinery by views of carding engines and spinning-rooms. As pictures they are ugly; as photographs they are indifferent; as conveying information they are worthless. All description of machinery and mechanism requires diagrammatic illustration, but it should be diagrammatic, not pictorial. Such illustration is abundantly provided in articles like "Clocks," "Forging," "Founding," &c., and in many cases such simple sketches might wisely have been substituted for more elaborate views of machines and apparatus, the action of which it is quite impossible to follow from a mere external picture. The phototype illustrations of carpets and of bookbindings are inoffensive and excusable, but they convey so poor an idea of the rich beauty of the coloured originals that we could do better without them.

Photographic reproductions, properly applied, are, of course, invaluable. The photomicrographs of fibres in the article on that subject show structure in a way that no other pictorial device could show it, and the same remark applies to the magnified views of sections of iron given in the article on "Iron and Steel."

ORGANIC CHEMISTRY OF NITROGEN.

The Organic Chemistry of Nitrogen. By Dr. Nevil Vincent Sidgwick. Pp. xii+415. (Oxford: Clarendon Press, 1910.) Price 14*s.* net.

THIS book will be welcomed by students of organic chemistry as one of the highly desirable monographs which, unfortunately, have been so rarely produced in this country.

In the preface the author informs us that the object of the book is primarily educational, and that it is in no sense intended as a work of reference; this object it fulfils admirably in most cases, but occasionally a few more references to literature would have been useful to the student who wished to acquire a fuller knowledge of a subject.

The subject-matter is treated under four divisions: (1) compounds with no nitrogen directly attached to carbon; (2) bodies containing one nitrogen atom attached to carbon; (3) compounds containing an open chain of two or more nitrogen atoms; and (4) ring compounds.

The first three divisions contain a much fuller and more detailed treatment of the subjects included in them than the fourth division, in which a few only of the more important cyclic compounds have been selected for discussion, and no mention is made of many groups, such as the pyrazolones or glyoxalines.

In chapter i. the nitrous and nitric esters are dealt with, while chapters ii. and iii. contain an excellent account of the amines.

Throughout the book the application of physical methods to the study of the problems of organic chemistry is continually brought to the notice of the reader, and the importance of the study of the mechanism of reactions and the quantitative side of the subject is emphasised: the latter is introduced by an excellent discussion on the strength of the amines as bases.

The constitution and reactions of the triphenylmethane dyes are treated very fully, but the account of the stereoisomerism of quinquevalent nitrogen compounds is not entirely satisfactory.

Chapter iv. contains an account of the amides, including a good discussion of the mechanism of the Hofmann reaction.

Derivations of hydroxylamine are dealt with in chapter v., in which the transformations of phenyl hydroxylamine are described very fully, and an admirable account of the isomerism of oximes is presented. The evidence for Hantzsch and Werner's hypothesis of stereoisomerism, culminating in the strongest argument yet adduced in its favour, namely, the resolution of oximino-cyclohexane carboxylic acid and into optically active components by Mills and Bain, is clearly expounded, but the statement that this theory is universally accepted is scarcely justified even now. A lucid account of the Beckmann transformation and its mechanism is also included in this chapter.

Chapters vi. and vii. deal with the nitroso- and nitro-compounds, and include a discussion of the constitution of the nitrophenols and their salts, the bearing of this on the problem of the relation of colour to constitution in these and similar substances, and also a very good account of the reduction of nitro-compounds and of the oxidation of amines.

The cyanogen compounds are described in chapter ix., in which the problem of the constitutions of hydrocyanic and fulminic acids and their salts occupies a prominent place. The evidence brought forward by Nef and other workers in support of the view that fulminic acid is the oxime of carbon monoxide seems now incontrovertible. None of the hypotheses suggested to account for the properties and reactions of hydrocyanic acid and the cyanides can be regarded as entirely satisfactory, but few will agree with the statement that "prussic acid is tautomeric, and is probably a mixture of two forms," since the same line of reasoning, as shown by Wade, would necessitate a similar assumption in the case of silver cyanide.

In division iii., chapter xi., which deals with the diazo-compounds, is the most interesting; here, however, we feel that the subject is not presented to the student in a way which makes him understand clearly the difficulties of the problem under discussion. Certain statements are put forward as if they were definitely established facts; whereas, on account of the experimental difficulties with which the problem is beset, the evidence on which some of these statements are based is not conclusive enough to justify one in accepting them without question. In the case of the diazo-compounds, the hypothesis of stereoisomerism does not rest on such a secure basis as in the case of the oximes, and it is still possible that the facts may be explicable on the basis of the structural laws without assuming stereoisomerism.

Uric acid and related compounds are treated briefly in chapter xv.

In division iv. the fatty diazo-compounds receive due attention, the pyridine and quinoline group are treated briefly, while coniine, piperine, and nicotine are the only alkaloids discussed.

A few errors, such as formaldehyde for formanilide (p. 82), and minerals instead of mineral acids (p. 209), were noticed, but we regret to find certain colloquial expressions, such as "A readily goes over into B," occurring so frequently; and the statement that a substance "can be broken up into two optically active forms," (p. 103), is hardly a correct or conventional description of the process.

The book contains excellent summaries of the present state of our knowledge on a large number of subjects, including many of the most controversial matters that have recently occupied the attention of chemists.

Usually the account of each subject will be found to include the most recent work of importance, though we notice the omission of the recent work on the mechanism of the transformation of chloroamines into chloroanilines.

Unfortunately the author often gives the impression that he treats a hypothesis or a theory as a fact, an attitude which we cannot regard as a desirable one for the student to adopt.

The student, for whom the book is intended, will find it will well repay careful study, and will discover in it much food for thought, while the author is to be congratulated on the production of a very useful work.

H. O. J.

SCIENCE AND HISTORY.

The Cambridge Modern History. Planned by the late Lord Acton. Vol. xii.: "The Latest Age." Pp. xxxiv+1033. (Cambridge: University Press, 1910.) Price 16*s*. net.

A COMPREHENSIVE and philosophical history of science in "The Latest Age" would be one of the most valuable and interesting works which it would be possible to produce, but it was not the purpose of the volume before us to produce it. Of its thousand pages only fifty have any special interest for students of science, the twenty-six pages of Mr. Whetham's chapter on "The Scientific Age" and the twenty-four pages of Mr. Rogers' "Modern Explorations." In so narrow a space it is not to be expected that there will be much that is novel or profound. Mr. Rogers can do little more than record a long list of names and dates; he cannot describe the effect upon modern civilisation of the discoveries without duplicating the work of other authors, to whom the reader is frequently referred. The present reviewer cannot express any judgment as to the accuracy or completeness of the list, but for these qualities the author's reputation is a sufficient guarantee. Mr. Whetham has rather more scope for comment, expressed with

the elegance which we expect from him; but even he can scarcely find room for any facts which are not familiar to every well-informed person, or any conclusions which are not the commonplaces of every journalist.

While nothing but praise can be given to the authors for the performance of their tasks, the decision of the editors that all the modern historian requires to know of the science of the last century can be contained in two short chapters seems at first to challenge criticism. But, so far as pure science is concerned, we believe that they are right. Pure science is the most esoteric of all studies; the power of appreciating the value of the ideas contained in the most fundamental scientific theories appears to be totally uncorrelated with any other form of mental ability. It is just because the scientific instinct is such a rare and peculiar gift that it is so intensely valuable. Even if it were possible for the mass of mankind to know truly the meaning of science, it is very doubtful whether it would have any effect upon those actions which history studies. Science cannot define a worthy aim for action; at most it can show what aims can be attained, not what ought to be attained. It was, of course, thought very widely forty years ago that what was "natural" was good, but the fallacy is quite exploded to-day. Indeed, it is probable that Spencerian sociology, based on the confusion of the biological and ethical meanings of the word "fit," would have never received any serious attention, had not the doctrine that what has survived ought to have survived been so comfortable to those in authority. All that the doctrine of evolution can teach us in the matter of aims is that man is master of his destiny, that it is neither sufficient nor necessary to wait for the dispensations of a mysterious providence, but neither the science of the last or of the next century will decide the eternally disputed question of what that destiny ought to be.

However, though pure science cannot give us ends, applied science can give us means, and in respect of applied science "The Cambridge Modern History" appears to us defective. There is no connected account whatsoever of the great inventions or the progress of engineering during "The Latest Age." Mr. Whetham, concerned with pure science, naturally only mentions discoveries which have been the by-products of pure research. We have bare references to photography, dynamos, telegraphy, and two pages concerning medicine, surgery, and hygiene. But many of the inventions which have had the greatest economic or historical effects have no immediate connection with pure science. Can the historian of to-morrow analyse the events of to-day if he has never heard of such things as telephones, explosion engines, modern armaments, water-power, or electric lighting? The most trivial invention in appearance may revolutionise the world. Mr. Whetham rightly says that "the locomotive engine and the electric telegraph effected the great industrial and social revolution of the middle of the nineteenth century"; we suggest that it would not be ridiculous to claim for an invention so uninteresting technically and scientifically as the bicycle a comparable influence upon the end of it. Besides its economic effect in increasing men's radius of action, its social effect in furthering the independence of women must surely make it worthy of the attention of a student of the modern state; and yet the editors of "The Cambridge Modern History" have no official knowledge of it.

THE THEORY OF FUNCTIONS.

Introduction à la théorie des fonctions d'une variable. By J. Tannery. Deuxième édition; tome 2. Intégrales définies, Développements en Série, Langage géométrique, Fonctions de Variables imaginaires. Avec une Note de M. Hadamard. Pp. iv+480. (Paris: A. Hermann et fils, 1910.) Price 15 francs.

THE most interesting chapter in this volume is that which is entitled "Langage géométrique," especially from a pedagogic point of view. The main object of the treatise is to deduce everything from purely arithmetical assumptions; but as a practical teacher, Prof. Tannery was well aware of the value of diagrams as an aid to the imagination, or, as he puts it, for purposes of orientation. Consequently he has given a series of quasi-geometrical definitions, by means of which the ordinary formulæ and methods of analytical geometry are valid, and may be used practically for constructing diagrams to define boundaries of aggregates, &c. In the ordinary sense, of course, we thus get a locus corresponding to an equation $\phi(x,y)=0$; but in order to emphasise the fact that only arithmetical conditions are really imposed, the author replaces the term "locus" (*lieu*) by "bond" (*lien*), and practically confines this to the case where we may put $x=\phi(t)$, $y=\psi(t)$, ϕ, ψ being definite functions for a certain range of the real continuous variable t. The principal results of the chapter are the proof of the existence of simple contours in a plane, which separate it into two distinct continua (this is given after Mr. Ames), and the further conclusion that a domain which is $(m+1)$ times connex can be reduced to two simply connex domains by drawing $(m+1)$ simple curves.

Another notion that occurs in this chapter is that of the order of a point A with regard to a closed contour C. If a point P traverses C once in the positive direction, the variation of the amplitude of the vector AP is of the form $2k\pi$, where k is some integer or zero; and k is called the order of A with respect to C. This very important idea was generalised by Kronecker, and the present volume concludes with an important note by M. Hadamard (pp. 437–77) on some applications of Kronecker's index. The main point of this theory is that the property of a Jacobian, that it changes sign when two rows are interchanged, is brought into connection with topology (or *analysis situs*) in a very general sense. Every advance in the analytical treatment of this subject is noteworthy; because it is here that the contrast between geometrical intuition and analytical proof is so often a glaring one. For example, take Minding's surface, which is obtained by taking a strip of paper, giving it a half-twist, and then pasting the free ends together. It is easy to see that this surface has only

one boundary and only one face, and that this property remains if the surface is "deformed" in the usual sense of that word. But it would be very troublesome to prove these facts analytically, and an ordinary person finds it hard to think of such a proof as being anything more than a superfluous *tour de force*.

Before leaving this chapter, attention may be directed to the use which is made of cuts (*coupures*) in the plane of reference. For certain purposes, as shown for instance by Hermite and Heine, it is more simple to use a plane with cuts in it than to construct a Riemann surface; and the beginner in function-theory may be recommended to master this method before proceeding to Riemann's.

The remaining chapters may be more briefly summarised. There is one on definite integrals introducing the indispensable notions of integrals by excess and defect, and functions of limited variation; one on development in series; two on complex variables and their functions; and one on the differentiation and integration of such functions. Very properly, the author has confined himself to well-known and comparatively simple functions as examples, and he has given figures to illustrate the conformal transformations effected by $\zeta = e^z$, $\zeta = \sin^{-1} z$, and so on. As incidental examples, we may mention the Eulerian functions, and Weierstrass's factorial formula for a function the zeros of which are given.

Mathematical teachers will doubtless find this work of great value, because it helps to suggest what is really practicable in a course of lectures on this subject. The fact is that the theory of aggregates, and the classification of functions, have become such an essential part of all analysis that they cannot be ignored. A serious mathematical student must understand what is meant by such terms as closed and open aggregates, limiting points, uniform convergence, &c., and know something of the conditions for differentiation and integration. But if, with excess of zeal, the lecturer tries to bring out every point, and to be impeccably logical, he runs a serious risk of boring his audience.

G. B. M.

PHYSIOLOGY OF REPRODUCTION.

The Physiology of Reproduction. By Dr. F. H. A. Marshall. Preface by Prof. E. A. Schäfer, F.R.S., and contributions by Dr. W. Cramer and Dr. J. Lochhead. Pp. xviii+706. (London: Longmans, Green, and Co., 1910.) Price 21s. net.

THE progress of science is very haphazard. For centuries the problems of breeding and heredity have engaged the attention of intelligent men, but it is only within the last five decades that any accurate scientific knowledge on the subject of breeding has been reached. Even now almost all our knowledge of this subject has been derived chiefly from a study of the results of the mating of two germ-cells. This one-sidedness is due to the processes which take place during reproduction being so little known.

This unequal advancement of the sciences is seen again in physiology. Here the physiology of digestion, of muscular contraction, of the nervous system, has been extensively studied, but that of reproduction has been largely neglected. Dr. Marshall has set himself to remedy this defect, and has collected all the available information on the subject. Reproduction incidentally concerns many different categories of people, and they have recorded their observations in numerous and varied periodicals and books. It must have been a task of considerable magnitude for the author to have collated all his sources of information; a glance at the references to quoted literature will convince us of this. The bibliography is in consequence not the least valuable part of the book.

But Dr. Marshall's volume is not merely a digested abstract of scattered papers taken from a great many journals; the author's own extensive work has given him an insight into his subject which enables him to impart information to his readers in a clear and lucid way. He has compiled a treatise which will remain a standard work for some time to come.

The work is to a great extent morphological, but, as everyone knows, it is absolutely necessary to have a sound knowledge of the structure of any organ before physiology is investigated. In studying such a process as the œstrus cycle, the exact morphological changes which take place in the uterus must first be known. This knowledge we owe to Heape, to whom we are glad to see the volume is dedicated, and it is the foundation of all our knowledge of the physiology of the œstrus cycle.

The author commences with a chapter on the breeding season of animals, examples being taken from invertebrates as well as vertebrates, but in subsequent chapters the higher mammalia are, with few exceptions, alone referred to. He then deals with the œstrus cycle and the changes which take place in both sexes both before and during reproduction. After this we have detailed all the evidence bearing on the changes in the maternal organs during pregnancy. The chapter on the biochemistry of the sexual organs seems only to show us how little we know, the information in it is so sparse and disconnected, and surely here is a valuable field for research. The last three chapters are on general questions of breeding, such problems as fertility and the determination of sex being dealt with.

Interspersed with the subject-matter we find the author's views on many theories as seen in the light of his own research. Thus, in the chapter on fertilisation, he gives a criticism of Mendelism. Close study of the actual physiology of reproduction does not lead the author to believe in the conception of unit characters, which the Mendelians have put forward. He speaks of the idea of attempting to locate latent characters of organisms in different parts of the germ-cell, as a survival from the times when all qualities, abstract or otherwise, were supposed to reside in different portions of the body. Whatever be the merits of this particular criticism, it seems that when further work has been done on the physiology of reproduction, a new mechanism may have to be supposed which will account for Mendelian facts, and fit in as well with the teachings of physiology.

Dr. Marshall has produced a masterly treatise

which gives us a very complete and critical review of all the facts of the physiology of reproduction. It will make a new "jumping-off place," as the Americans says, in research, and it is, moreover, admirably written. As an eminent gynæcologist said, "It is as interesting as a novel." It is a text-book which will be a great help to all those who are already working at the science, and a stimulus to encourage new workers. To everyone who is interested in breeding we would recommend this book, though it is not, however, in any sense a popular work.

SOUTH AFRICAN CRUSTACEA.

Annals of the South African Museum. Vol. vi., part iv., 6: *General Catalogue of South African Crustacea* (part v. of S.A. Crustacea, for the Marine Investigations in South Africa). By the Rev. T. R. R. Stebbing, F.R.S. Pp. 281–593, plates xv–xxii. (Cape Town: South African Museum; London: West, Newman, and Co., 1910.) Price 27*s*.

IN the study of the geographical distribution of marine animals, certain regions are of special significance from the fact that they lie on the borderlines between contrasted faunal areas, and offer, or may have offered in the past, possible routes of migration from one to the other. One of these critical regions is found at the Cape of Good Hope, where the faunas of the Atlantic, the Indo-Pacific, and the great southern oceans meet and, to some extent, overlap.

In recent years much information regarding the fauna of the Cape seas has been obtained in the course of investigations conducted under the superintendence of Dr. J. D. F. Gilchrist for the Cape Government, and published under the general title of "Marine Investigations in South Africa." To this series Mr. Stebbing has already contributed four important memoirs on the crustacea. In a fifth memoir, now published, he brings together the results of his own work and that of his predecessors who have dealt with this groups of animals, in a "General Catalogue of South African Crustacea," including the freshwater and terrestrial as well as the marine species.

In the present state of faunistic carcinology it is hardly possible to over-estimate the usefulness of such a catalogue, prepared, as it has been, with the thoroughness and detailed precision characteristic of all Mr. Stebbing's writings. Apart from the descriptions and figures of the numerous new and interesting species, the compilation of the bibliographical references alone must have involved a great amount of labour, of which subsequent students will reap the benefit. Although Mr. Stebbing touches only incidentally on geographical problems, his catalogue will provide a sure basis for future work on this subject.

As an example of the interesting points of detail contained in these memoirs, the case of the Cape lobster, *Homarus* (or, as Mr. Stebbing prefers to call it, *Astacus*) *capensis* may be mentioned. This pretty little species has been involved in obscurity since its first description in 1792 by Herbst, who stated that it lived in mountain streams at the Cape. H. Milne-Edwards later gave a brief description of the species, but added no information as to its habitat. Huxley, referring to it, says:—

"I must confess myself to be in a state of hopeless perplexity respecting the crayfish or lobster which is said to occur at the Cape of Good Hope."

Mr. Stebbing now supplies a full description of the species from specimens sent to him by Dr. Gilchrist, and finally disposes of the story as to its freshwater habitat. Like the other two species of the genus, the European and American lobsters of the north Atlantic, it lives in the sea, and its remoteness from the areas occupied by its congeners offers a noteworthy example of "discontinuous distribution." It may be mentioned in passing that the only figure of the Cape lobster referred to by Mr. Stebbing is the original one of Herbst, which is very inaccurate. An excellent figure was given by H. Milne-Edwards ("Ann. Sci. Nat., Zool." (3), xvi., 1851, plate xi., Fig. 1); but as it occurs among the illustrations of a morphological paper, it is easily overlooked.

Mr. Stebbing's use of the generic name *Astacus* for the Cape lobster affords an instance of the difficulties into which "reforms" of nomenclature may lead the unwary student. In this case the detailed synonymy which Mr. Stebbing gives prevents any ambiguity, but, unfortunately, other writers are not so careful, and, in view of the long-standing error as to its freshwater habitat, it may not be superfluous to warn the student of geographical distribution that "*Astacus capensis*" is *not* a crayfish.

In many other points of nomenclature the catalogue challenges criticism. Mr. Stebbing is well known as an uncompromising advocate of the strict rule of priority, but he is by no means ready to surrender the right of private judgment, and is even capable of treating disrespectfully the decisions of the International Commission on Zoological Nomenclature. At all events, whatever may be the case with genera and species, there is no law to compel, nor any perceptible advantage to recommend, a renaming of the accepted orders and subclasses of crustacea; and there can be little doubt as to the opinion of zoologists in general on the proposals to substitute Thyrostraca for Cirripedia and Ostrapoda for Ostracoda.

W. T. C.

SCIENCE FOR THE GENERAL READER.

Science in Modern Life. Prepared under the Editorship of Prof. J. R. Ainsworth Davis. Vol. v. Pp. ix+207. (London: The Gresham Publishing Company, 1910.) Price 6*s*. net.

THIS volume comprises four contributions, namely, by Prof. James Wilson on agriculture (32 pp.), by Dr. John Beard on philosophical biology (32 pp.), by Prof. Benjamin Moore on physiology and medicine (90 pp.), and by Dr. H. Spencer Harrison on anthropology (52 pp.).

The first article is almost entirely historical; it contains an account of the chief advances in British agriculture from Saxon times, but has little to say on present-day problems and researches. More space

might, with advantage, have been devoted to these subjects.

Dr. Beard gives, in his opening chapter, a concise statement of the views associated with the names of Lamarck, Spencer, Darwin and Wallace, and Weismann. The following chapter, on heredity, deals in turn with Galton's law, Weismann's theory of the germ plasm and with germinal continuity. The third chapter discusses Mendelism, biometry, and the mutation theory of De Vries. Dr. Beard's views can be best summarised by quoting the statement at the head of the concluding chapter—

"The phenomena of heredity and genetic variation appertain to the germ-cells, that is, they are germinal in nature. All ancestry passes through a continuous line of germ-cells, and never through the cells of the individual (somatic cells) containing the germ-cells. An 'inheritance of acquired characters' is impossible, for there is no handing on of anything. The individual is merely a terminal and lateral offshoot. In the higher animals direct development, a building up of the individual, and a somatic origin of germ-cells, do not exist. . . . The formation of an individual is a mere incident in a certain chain of events."

He concludes by stating his belief that unconscious memory, in Hering's sense, is sufficient to account for heredity as exhibited by living things, and that if this be recognised "much that has been imagined becomes, not merely futile, but an unnecessary multiplication of causes."

Prof. Moore has given an interesting account of the functions of many of the different kinds of cells of the body, for instance, the leucocytes, the red blood-cells and their adaptation of form to their special functions, the intestinal cells and their secretion, the ductless glands and internal secretions, &c. Clearly written explanations, as free from technicalities as possible, are given of many of the new terms used in modern medical science, *e.g.* agglutinins, anti-bodies, opsonins, precipitins, antisera, hormones, &c.

The chapter on tropical diseases is much too short. The only diseases considered are malaria and sleeping sickness, and the account of the former contains a considerable number of imperfect or inaccurate statements. The following occur on one page (144) (1): "The mosquito was found to develop a special cycle of the malarial parasite in the glands of the stomach," which is a very loose statement of the matter; nothing is said of the presence of the parasites in the salivary glands of the mosquito, or of their mode of entry into a new human host. (2) The changes in the organism of malaria which take place in the mosquito are designated "certain preliminary stages of development," which surely gives but a faint idea of the fundamental changes which actually occur. (3) Mosquitoes do not deposit larvæ, as asserted, but lay eggs. (4) It is stated that the larvæ, "in order to develop further, must at a certain period ascend to the air at the surface of the water"; as a matter of fact they must ascend periodically, and in most cases frequently, in order to obtain the necessary air. Laveran is not Italian, as stated on p. 143, and the first trypanosome in a European was described by Dutton, not Dalton (p. 145). We should have thought that the recent campaigns against Stegomyia (not Stegomya, p. 144) and yellow fever were worthy of more than casual mention, and that several other tropical diseases were of sufficient general interest to make reference to them desirable. Figures of Anopheles and a tsetse-fly would have been helpful to the reader.

In the short chapter on public health, the author shows how the general health of the community has improved, and urges the necessity for segregation of, and vigilance regarding, cases of consumption.

Dr. Harrison outlines in an interesting manner the chief phases of development of anthropology; the origin of man, of inventions, of civilisation, and of the races of man, are discussed, and an account is given of the races of Europe and of Britain. The article is illustrated by several excellent photographs and a number of coloured and line drawings.

OUR BOOK SHELF.

The Niger and the West Sudan, or the West African's Notebook. A Vade Mecum containing Hints and Suggestions as to what is Required by Britons in West Africa, together with Historical and Anthropological Notes, and Easy Hausa Phrases Used in Everyday Conversation. By Captain A. J. N. Tremearne. Pp. viii+151. (London: Hodder and Stoughton, and A. H. Wheeler and Co., n.d.) Price 6*s.* net.

THIS book is written by a former Hausa scholar of Cambridge, who is also a doctor in anthropology, and the work is the result, seemingly, of some years' residence in Nigeria, with visits to the British colonies *en route*. It contains a good many vocabularies of English-Hausa interspersed amongst the chapters, and some of these will no doubt be of much use to officials and travellers residing in or visiting these regions. There is a great deal of general information about British West Africa, but little evidence of independent research on the part of the author, while the quotations with which the book is studded are of a somewhat ancient and well-worn character. Some recent French and German works (historical, geographical, anthropological, &c.) are overlooked, though they throw a new light on the ancient history of British possessions in West Africa, as well as of the adjacent regions under other flags.

A somewhat contemptuous attitude is taken up with regard to the educated negro, which seems to be derived less from the author's own observation and experience than from the pessimistic views expressed by writers and travellers of half or a quarter of a century ago. In reference to the youth trained at Government or missionary schools—in Sierra Leone, for example—the author seems to be quite unaware of the part played by these intelligent and active young men—engineers, artisans, clerks, &c.—in the opening up of the interior of that colony, or in like manner of the Gold Coast.

In drawing up a list of societies and institutions which may be of use to the African official or student, the writer of this book omits all mention of the African Society, which is surely one of the most useful, for its journal contains the best and latest information on West African subjects. The portion of the work which deals with the Hausa people (chiefly by quotations) possesses some interest, but contains fantastical notions, original and borrowed, which may only mislead the student, such as, for example, the suggested derivation of Hausa from Habeshi

(Abyssinian). Nevertheless the book under review sums up in small compass much of the interest of northern Nigeria.

Lehrbuch der allgemeinen Pflanzengeographie, nach entwickelungs-geschichtlichen und physiologisch-ökologischen Gesichtspunkten. Bearbeitet von Prof. P. Graebner. Mit beiträgen von Prof. P. Ascherson. Pp. viii+303. (Leipzig: Quelle and Meyer, 1910.) Price 8 marks.

No branch of botany has advanced more rapidly in the last quarter of a century than the study of plant geography or distribution. Although the foundations were laid by Humboldt (1805), de Candolle (1855), and Grisebach (1872), much of the impetus is due to the influence of the already classical works of Warming and Schimper, and to the valuable contributions by Dr. Engler; further, the numerous recent papers devoted to the descriptions of vegetation in all parts of the world have provided additional data for establishing general principles.

Plant geography presents the two main aspects of distribution in space and distribution in time. The former has received more attention, and provides the sole topic of most books on the subject. Dr. Graebner has devoted a third part of his book to an account of development in past geological ages and in historical times. This provides a serviceable epitome, although some of the statements—as, for instance, the suggested aquatic habit of the Sphenophyllaceæ—are questionable. The discussion of events in the Tertiary and Glacial periods leads up to such matters as plant migrations, centres of distribution, origin of new species, variation, casuals, aliens, and colonists. Distribution in space is taken in two sections, of which the first relates to floristic kingdoms, the second to ecological conceptions. The consideration of the subject from these two points of view would serve a useful purpose if the advantage was not discounted by the excessive condensation necessitated. The description of causes influencing plant distribution in the present day contains a store of details gleaned from scattered papers, and provides much material for elaboration. Very little space is apportioned to the account of plant formations; their classification is based upon the paucity or richness of the available food supply in the soil. Numerous references to original publications are supplied in the footnotes, which it would seem worth while to collect into an appended classified bibliography.

The Natural History of Coal. By E. A. Newell Arber. Pp. x+163. (Cambridge: University Press, 1911.) Price 1*s*. net.

Within the narrow compass of this little volume, which forms one of "The Cambridge Manuals of Science and Literature," Mr. Newell Arber has condensed a great amount of solid information with respect to the nature of coal, and much speculation with regard to its probable mode of formation. Perhaps the most notable feature of the work is the emphasis which it lays on the fact that "coal" is merely a group-name, applied popularly to a number of carbonaceous substances, very varied in character and doubtless very diverse in origin. No one mode of formation is applicable to all coal. If it can be proved in a particular case that the vegetation from which the coal was originally formed must have grown on the spot where it is now found, we are by no means justified in denying that in other cases the vegetable *débris* may have been drifted to its present site.

The author holds that each group of coal-bearing rocks, even each seam of coal, must be studied and judged on its own merits. The material from which coal has been formed he calls "the mother-substance of coal"—an expression not to be confused with the term "mother of coal," which has long been applied, perhaps not very appropriately, to the substance known otherwise as mineral charcoal. Mr. Arber discusses, with much command of his subject, the character of the coal-forming vegetation, the mode in which its relics accumulated, and the changes to which they have been subjected in the process of coal-making.

The view which regards the formation of palæozoic coal as having been comparatively rapid finds favour with the author, whilst doubt is thrown on the popular "peat-to-anthracite theory." As to the vexed question of the climate of Upper Carboniferous times, Mr. Arber hesitates, for apparently good reason, to term it tropical.

Eine Botanische Tropenreise. Indo-Malayische Vegetationsbilder und Reiseskizzen. By Prof. G. Haberlandt. Zweite Auflage. Pp. viii+296. (Leipzig: W. Engelmann, 1910.) Price 11.60 marks.

There is very little change to note in the present edition of Haberlandt's "Botanische Tropenreise" as compared with the original that was published in 1893. A few paragraphs have been inserted here and there, some excellent reproductions from photographs have been added, and three coloured reproductions from water-colour sketches by the author. It would have been unwise to reconstruct the general text, which records the fresh impressions of a first visit to the tropics. The chapters on tropical leaves and trees, lianes, epiphytes, and mangroves are specially instructive, and the bold pencil sketches delineate characters which are not discernible in a photograph.

Star People. By Katharine Fay Dewey. With illustration by Frances B. Comstock. Pp. x+232. (London: Longmans, Green, and Co., 1910.) Price 6*s*. net.

Some of the mythological characters which figure among the constellations are here introduced into a fantastic story. We cannot believe that the original legends have been improved by their setting, or that there is anything particularly inspiring in the association of stars with nonsense talk and a giggling company. Draco is afflicted with a lisp, and is made to say on one occasion "That'th all right. I gueth I can walk with three girlth. I'm long enough!" The constellations are so beautiful and the dramas they represent are so rich in imaginative ideas that we should prefer not to introduce children to either through a story of this kind, which can scarcely be regarded as good literature and is certainly not good science.

With Nature and a Camera: Being the Adventures and Observations of a Field Naturalist and an Animal Photographer. By Richard Kearton. Illustrated by 180 pictures from photographs by Cherry Kearton. Popular edition. Pp. xvi+368. (London: Cassell and Co., Ltd., 1911.) Price 5*s*.

Its re-issue in a cheaper form should increase the already wide popularity of this attractive book. The character of the work was described in Nature soon after its appearance (vol. lvii., p. 154).

British Birds in Their Haunts. By the late Rev. C. A. Johns. Twelfth edition, with 16 coloured plates. Pp. xxxii+626. (London: Society for Promoting Christian Knowledge, 1911.) Price 5*s*.

A book which has reached its twelfth edition needs no commendation. It is evident that its clearly expressed descriptions have proved of real assistance to students of bird-life.

Das Wasser. By Dr. O. Anselmino. Pp. vi+122. (Leipzig: B. G. Teubner.) Price 1.25 marks.

THIS booklet is the 291st volume of a popular scientific and literary series. It embodies the material used in a course of experimental lectures given at Griefswald in 1907. The subjects dealt with include the chemistry of water, mineral waters, the purification of water, drinking water, mineral waters, and diffusion. The text is illustrated by forty-four diagrams, most of which have been taken from text-books of chemistry, to which due acknowledgment is made. The author has brought together a large array of facts, the tabulated analyses of various waters, including a long series of mineral waters, being a conspicuous feature of the book. The chapter of chemistry covered by the title is an important one, and it is probable that its treatment in a separate volume may prove to be a convenience to a considerable class of readers.

What Nature Is. An Outline of Scientific Naturalism. By Chas. K. Franklin. Pp. iv+74. (Boston: Sherman, French and Co., 1911.) Price $0.75 net.

A WELL-WRITTEN argument for "scientific naturalism" as against the argument from design, which sees intelligence in nature, inferring therefrom a creator. Mr. Franklin rejects anthropomorphic theism, also idealism, but seems to finish up in a kind of mysticism. "It is the character and quality of matter and energy to develop" man and the social process, just as it is for them to manifest themselves in the inorganic and organic processes. New thoughts, feelings, volitions, religion, &c., are merely manifestations of "radiant and gravitant energy." But somehow we shall eventually "be able to comprehend what the universe is, conceive infinite time and infinite space by looking in upon ourselves and seeing the infinite repeated in us, and understand the inmost nature of things. Just as the time was when life was not self-conscious, then became self-conscious and class-conscious, and to-day is imperfectly socially conscious; and so the time will come when we shall be universally conscious" (pp. 71–72).

Perhaps so; it is interesting as a speculation, and the author has probably been reading Dr. Bucke's "Cosmic Consciousness." But Mr. Franklin is rather dogmatic, and is a little apt to slide into speculation suddenly after writing a good deal of sensible science; the reader therefore has to keep an eye on him, and to guard against too hasty following. Moreover, the reduction of everything to "energy" does not in the least resolve the ultimate mystery of things, as Tyndall, for instance, saw plainly enough.

Morale de la Nature. By M. Deshumbert. Second edition. Pp. 96. (Paris: Schleicher Frères, 1911.) Price 1.50 francs.

WE have here the second French edition of a book which, since its first appearance, has been translated into English by M. I. M. Hartmann, and published by Mr. D. Nutt, under the title, "The Ethics of Nature." The original work led to the formation of the "Ethics of Nature Society," which is an association for the harmonious development of life. The present edition of M. Deshumbert's book has been revised and enlarged.

Carnations and Pinks. By T. H. Cook, J. Douglas, and J. F. McLeod. With eight coloured plates. Pp. xi+116. (London: T. C. and E. C. Jack, n.d.) Price 1s. 6d. net.

THE latest addition to the "Present-Day Gardening" series will be welcomed by all active horticulturists. Being the work of expert cultivators of the flowers with which it deals, the volume should soon become widely known and consulted on account of the practical hints it contains.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Stability of Aëroplanes.

THE following simplification of Lanchester's formula for longitudinal stability of tailed monoplanes may be useful.

His formula is

$$\Phi = \frac{4l\mathrm{H}_n^2 \tan\gamma}{\mathrm{I}\left(\frac{1}{\mathrm{K}} + \frac{1}{c\mathrm{C}\rho\epsilon\alpha\beta}\right)}.$$

("Aërodonetics" ρ 101).

Here H_n is the height corresponding to the normal velocity of the machine $= \mathrm{V}_n^2/2g$ and $\mathrm{I} = \mathrm{WR}^2$ where R is the radius of gyration about a transverse axis through the centre of gravity, and K is $g\mathrm{W}/\mathrm{V}_n^2$, where W is the mass in pounds.

$c = 3{\cdot}0$, $\mathrm{C} = 0{\cdot}7$, $\rho = 0{\cdot}08$ pounds per cubic foot, $\epsilon =$ about $0{\cdot}6$ for tails of moderately high aspect ratio, so that $c\mathrm{C}\rho\epsilon = 0{\cdot}1$ nearly.

Hence

$$\Phi = \frac{l\mathrm{V}_n^4 \tan\gamma}{g^2\mathrm{R}^2\left(\frac{\mathrm{V}_n^2}{g} + \frac{10\mathrm{W}}{\alpha\beta}\right)}.$$

(See "Problem of Flight," 2nd edition, p. 114.)

For most machines with pterygoid aërofoils of approved camber γ and β are about $\frac{1}{6}$ radian.

Further the value of W (pounds not poundals) is connected to the supporting area by approximately the equation $\mathrm{W} = 0{\cdot}0016\ \mathrm{AV}^2$ so that $\mathrm{V} = 20$ to $30\sqrt{(\mathrm{W/A})}$, or say $30\sqrt{w}$, where w is the lift in pounds per sq. foot.

Hence approximately

$$\Phi = \frac{l \times 30^4 \times w^2 \times \frac{1}{6}}{1024\mathrm{R}^2\left(\frac{30\sqrt{w}}{32} + \frac{10\mathrm{W}}{a \times \frac{1}{6}}\right)}$$

taking $\Phi = 1{\cdot}5$ and writing $\mathrm{W} = w\mathrm{A}$, we get very nearly

$$l = \frac{\mathrm{R}^2}{500}\left(w^{-\frac{3}{2}} + 60w^{-1}\frac{\mathrm{A}}{a}\right)$$

thus expressing the length of the tail in terms of the radius of gyration, the loading per sq. foot, and the ratio of the supporting area to the tail area.

For example, if $\frac{\mathrm{A}}{a} = 10$, and $w = 2$ lbs. per sq. foot,

$$l = \frac{\mathrm{R}^2}{500}\left(0{\cdot}35 + 300\right) \text{ or roughly } \tfrac{3}{5}\mathrm{R}^2.$$

Thus a machine the radius of gyration of which is 7 feet, loading 2lbs. per sq. foot, and having 10 per cent. tail area, needs a tail with $\frac{3}{5} \times 7^2$, say 30 feet radius of action (*cf.* Bleriot machine).

HERBERT CHATLEY.

Tâng Shan, Chih-Li (*via* Siberia), February 27.

The Daintiness of the Rat.

ONE of the principal sights in Bordighera is the garden of the Villa "Charles Garnier." It is called after its late owner, the famous designer of the Grand Opera at Paris and the Casino at Monte Carlo. It was probably when he was engaged in building the Casino that he acquired the large and valuable property which bears his name.

The garden covers more than five acres, and is a mass of tropical and subtropical vegetation. The banana trees bear fruit which ripens every year. The gardener, a very civil and intelligent man, speaks English, and he told me he had worked for more than a year in Kew Gardens, which he much admires, and endeavours to imitate when his means permit. He was especially proud of his ticketing the plants after the Kew model.

Not being a botanist, I was unable to appreciate adequately his attention in showing me the treasures of his garden, and it was perhaps owing to his perceiving

this that he directed my attention to an allied circumstance which interested me much.

He informed me that the greatest trouble which he had was with rats, the *forest rats* he called them. They spend the winter in the garden, and, while causing a good deal of general damage, they evince a remarkable selectiveness in their taste for fruit. It appears that they have a great preference for the lemon and the mandarin, which are abundant in the garden. A number of the trees carried zinc guards on their trunks to prevent the ascent of the rats; but in a terraced garden on a steep slope there are many which cannot be protected in this way, because a rat easily jumps from a higher terrace on to the upper branches of a tree growing on the terrace below. By this means they had boarded and plundered quite a number of trees. They touched only the lemon and the mandarin trees, disregarding the common orange. But what seemed to be most remarkable was the different way in which they treated the fruits of these two trees. Of the lemon they eat the rind, removing it completely, and leaving the peeled fruit, clean and without a blemish, still attached to the branch which carried it. On one tree there were eight or ten such freshly peeled lemons still in their places on the tree, and they presented, among the others, a very curious aspect of nakedness. Having boarded a mandarin tree, the rat treats the fruit in the opposite way; he eats the inside and leaves the empty skins hanging on the tree. On one tree that I saw, nearly the whole of the fruit had been treated in this way. Something similar may be witnessed with us on gooseberry bushes in a summer when wasps are abundant. The reason for the different treatment of the two fruits is probably not to be sought further than in the fact that the inside of the mandarin is sweet and that of the lemon sour.

So long as there are mandarins and lemons, the common orange remains untouched, but when there are no more of these two they eat the common orange. By the time these are finished the fields and woods outside are beginning to furnish food, and the rats leave the garden, not to return until the winter begins again.

In answer to my inquiry, the gardener said the rats never attempt to enter the villa; they are forest rats. I asked him if they were a special kind; he said they were brown rats; and I asked him if they were different from the rats he had seen in England, and he said no.

The daintiness of the rat, shown not only in the choice of his fruit, but also in the part of it which he will eat, is not the only feature of rat life which is illuminated by the experience of the gardener of the Villa "Charles Garnier." The annual migration back and forward from the open and natural surroundings of the field and forest, where in summer food is being naturally produced in abundance, to the restricted environment of the highly cultivated garden, where in winter food is produced only by artificial devices, becomes more remarkable the longer it is contemplated. The whole area of semi-tropical garden on the Riviera is an insignificant quantity compared with that of the open ground, so that the proportion of the rat population which is able to enjoy the winter *villegiatura* must be very small, and must be chosen or evolved by a rigorous system of selection, which probably rests on the fundamental principle, the right of might.

In a fertile country like that of Liguria the rats, which are obliged to remain *fore le muri*, are no doubt able to pick up a subsistence during the winter, but they cannot afford to be so dainty as those that are able or privileged to occupy the gardens. In any case, I suppose, it may be taken to be true that a hungry rat will not hesitate to eat a healthy brother rat if he can waylay him or overcome him in combat. It is not improbable that this is the natural winter food of many tribes of rats which inhabit countries where food has its seasons of plenty and scarcity. The shortage thus produced in the winter is quickly made up by the splendid fruitfulness of the mother rats when the food season returns, and the population, over the year, need show no diminution; indeed, there is nothing to prevent it showing an increase. In nature there are accumulators of all kinds.

We have seen, on the evidence of the fruit trees of the garden, that the rats occupying it must live in that state of luxury in which the sensation of real hunger is not felt. How do they keep such a garden of Eden to themselves?

That the common oranges remain as a reserve to the end of the season shows that overcrowding is effectively prevented. We have seen that the lemon and the mandarin are preferred by the rats actually occupying the garden, and apparently indifferently, because the two fruits are consumed *pari passu*. As it is contrary to the animal nature for the strong to give way to the weak, we may feel certain that there is no relative aversion to either the lemon or the mandarin as there is to the common orange, or one of them would be consumed before the other.

All these facts go to show that the occupying force must be a very well-organised body, and must be directed by that degree of intelligence which teaches it, not only to drive and keep out strangers, but also rigorously to keep down its own numbers to the point at which it can, on the basis of experience, expect to pass the winter without being reduced to the necessity of eating common oranges.

Bordighera, March 20.

J. Y. Buchanan.

The Fox and the Goose.

The interesting story concerning a fox and its fleas related by Prof. McKenny Hughes recalls one told me many years ago by an old gamekeeper on Lord Ilchester's estate at Redlynch, in Somerset. The park at Redlynch is enclosed with a rough wall about 5 feet high; the keeper's cottage is in the line of this wall.

He saw one day, whilst sitting in one of his rooms, a fox coming towards the wall carrying a goose, which it had slung over its shoulders and was holding by the neck. Upon reaching the wall it tried to jump or clamber upon it, but failed. It repeated the attempt two or three times, going back a little distance and readjusting its burden each time before doing so. Finding that it could not get over in this way, it stood on its hind legs with its front feet against the wall, and, holding the goose by the neck close to the head, pushed the bill into a crack between the stones. The goose fell down, the crack being apparently too wide. A second attempt was successful, and the bird dangled from the wall suspended by the bill at almost 4 feet from the ground. The fox then leapt upon the wall, and leaning over withdrew the bill from the chink, hoisted up the bird, and disappeared with it on the other side.

E. W. Swanton.

Sir Jonathan Hutchinson's Educational Museum, Haslemere, March 28.

The Rusting of Iron.

In an article in Nature of March 2 on the rusting of iron, an objection was raised to the work of Lambert and Thomson (Trans. Chem. Soc., 1910) on the ground that their experiments were carried out in fused quartz vessels. The writer of the article puts forward the view that fused quartz dissolves in water to produce silicic acid; that the acid produced is sufficient to dissolve the iron; that enough iron will be dissolved by the process in the course of a few hours to produce, in the presence of pure oxygen, a visible quantity of ferric oxide! He cannot have supposed that the *probability* which he discusses was not considered by the authors. The object of the work was to bring together iron, oxygen, and water, all of the highest obtainable purity, and to let them react in vessels which would be least likely to affect the reaction.

It was only after most careful experiments on the suitability of quartz vessels that they were finally chosen. A long series of experiments, lasting over several months, was carried out, in which (1) fused quartz vessels, carefully cleaned, as described in the paper, (2) fused quartz vessels lined with purified paraffin wax, (3) Jena glass vessels lined with purified paraffin wax, were used under exactly the same conditions.

The experiments were carried out as described in the paper. The apparatus was evacuated down to 0·0001 millimetre (as measured by a McLeod gauge); water was distilled in from a solution of pure baryta, the conditions being such that the water which came in contact with the

iron could only have condensed on the inside of the tube in which the metal was contained.

Oxygen, made by electrolysis of pure baryta solution, was finally allowed to enter the vessels. The paraffin wax used to line the quartz and glass vessels was purified by boiling with many changes of "conductivity" water, with frequent shaking, for about 100 hours. The iron used was a commercial electrolytic sheet iron containing 99·9 per cent. iron. It was carefully cleaned with finely divided carborundum.

The results were the same in the quartz vessels and in the quartz and glass vessels lined with paraffin wax. Rusting was visible in all cases within a few hours.

It was only when pure iron, made as described in the paper, was used that no rusting took place.

After these and other experiments, it was considered that quartz vessels, which lend themselves admirably to cleaning and purification, were the most suitable vessels in which to study the reaction.

It is claimed by the authors that they have established the following facts:—(1) Pure iron does not rust when placed in contact with pure water and pure oxygen. (The term pure is used, of course, in a relative sense.) (2) The contention that "the *dominant* factor in the atmospheric corrosion of commercial iron is carbonic acid," or any other acid, is untrue. This must not be taken to mean, however, that carbonic acid plays no part in the atmospheric corrosion of ordinary commercial iron.

Bertram Lambert.
Chemical Department, University Museum, Oxford.

The reference made to Mr. Lambert's work in my note on the rusting of iron has already proved of value in eliciting from the author a statement in reference to tests carried out in vessels lined with purified paraffin wax. His statement does not, however, provide a solution of the problem to which attention was directed, namely, that commercial iron exposed freely to air and water under the conditions described by Moody and by Friend does not rust, whereas in his own experiments rusting took place in the case of all but the most highly purified samples. It is difficult to predict whether the essential difference which still awaits discovery will ultimately be found in the iron, in the air, in the water, or in the vessel, but it is to be hoped that further discussion—in the columns of Nature or elsewhere—may speedily throw light on this difficult and important matter.

It is a common experience, of which Mr. Lambert's work has provided excellent illustrations, that an unsuspected impurity (such as platinum in iron) is far more likely to promote than to prevent chemical change. It was for this reason that attention was directed first to the experiments in which rusting actually took place rather than to those in which it was successfully prevented. My suggestion in reference to silicic acid is correctly described, but I do not think that a note of exclamation was called for in view of the fact that mere contact with glass, as Moody found, actually produces the effects referred to, not in oxygen, but in purified air. The quantity of acid required to initiate the rusting must be extremely small, but its complete removal seems to outweigh in importance every other factor that may be taken into consideration. This view is amply supported by the fact that Friend, using common iron, common air, and the simplest apparatus, was able to stop the rusting by the simple device of washing the iron with a common alkali and then rinsing it with common water evaporated from the alkali and condensed on the iron.

With the first of Mr. Lambert's claims I am entirely in agreement; his second claim I regard as unproved and fallacious. To the statement that "the dominant factor in the atmospheric corrosion of commercial iron is carbonic acid" I adhere unreservedly, not only because the corrosion can be stopped by the addition of an alkali or by the removal of acid, but even more emphatically because the carbonic acid leaves behind an irrefutable proof of its activity in the presence of something like 10 per cent. of ferrous carbonate in the rust formed under the commonplace conditions to which I referred. T. M. L.

April Meteors.

The following are the most important meteoric events that become due from about April 6 to April 30 in the present year:—

Epoch April 5, 21h. (G.M.T.), approximately second order of magnitude. Principal maximum April 6, 21h. 55m.; secondary maximum April 6, 1h.

Epoch April 7, 17h, eighteenth order of magnitude. Principal maximum April 9, 9h. 40m.; secondary maxima April 8, 2h. 15m., April 8, 11h. 30m., and April 9, 21h. 30m.

Epoch April 10, 17h., twenty-third order of magnitude. Principal maximum April 9, 0h. 15m.; secondary maxima April 8, 21h. 15m. and April 10, 14h. 30m.

Epoch April 11, 4h., twenty-eighth order of magnitude. Principal maximum April 11, 11h. 15m.; secondary maximum April 12, 7h. 15m.

Epoch April 13, 22h. 30m., thirty-third order of magnitude. Principal maximum April 14, 15h. 40m.; secondary maximum April 15, 14h. 40m.

Epoch April 17, 17h., twenty-ninth order of magnitude. Principal maximum April 18, 2h. 15m.; secondary maximum April 18, 4h. 50m.

Epoch April 19, 8h., twenty-fourth order of magnitude. Principal maximum April 17, 13h. 40m.; secondary maximum April 17, 21h. 45m.

Lyrid epoch April 19, 14h. 30m., approximately eighth order of magnitude. Principal maxima April 17, 20h. 50m., and April 19, 9h. 50m.; secondary maxima April 19, 9h. 30m., and April 19, 11h. 40m.

Epoch April 23, 3h. 10m., approximately sixth order of magnitude. Principal maximum April 21, 16h. 40m.; secondary maxima April 21, 3h. 55m., and April 22, 20h. 30m.

Epoch April 25, 6h. 30m., eleventh order of magnitude. Principal maximum April 23, 13h.; secondary maxima April 23, 23h. 30m., and April 24, 22h. 50m.

Epoch April 26, 6h., thirty-first order of magnitude. Principal maximum April 27, 12h. 10m.; secondary maximum April 27, 4h. 40m.

Epoch April 27, 1h., approximately tenth order of magnitude. Principal maximum April 28, 22h. 50m.; secondary maximum April 27, 23h. 50m.

Shooting stars should be numerous on April 19, as several maxima occur shortly before midnight on this date, among which Lyrids and bright meteors from allied radiants will probably be strongly in evidence. There is also another Lyrid display on the night of April 21, but it will only be partially visible on this side of the Atlantic.

April 3. John R. Henry.

Insurance against Rain.

As this scheme of insurance is one of the few of which data can be obtained by "the man in the street" from which the odds in favour of the underwriters can be calculated, I went to the trouble of investigating the matter. Possibly the results may interest your readers.

In "British Rainfall" for 1909, by Dr. Hugh Robert Mill, statistics are given of the number of days on which varying quantities of rain fell. The figures give the average for thirty-seven rainfall stations in England and Wales over a period of seven years, 1903–9. From these, by a method of interpolation, it is found that fifty-eight days in a year may be expected to show a fall of 0·20 of an inch or more, and seventy-four of 0·15 or more.

Working out the probabilities on the basis of these figures, assuming that rain on one day is independent of rain on any other day, the following results are obtained:—for every 100*l.* received in premiums the underwriters may expect to have to pay, in the case of Policy A, 66*l.*; Policy B, 74*l.*; Policy C, 43*l.*; and Policy D, 64*l.*

In favour of the underwriters is the fact that in the south and south-east, where alone the scheme is applicable, the probability of rain is less than in England and Wales generally. A further point in their favour is that the summer months are less wet than the mean of the whole year on which the above figures are calculated.

C. O. Bartrum.
32 Willoughby Road, Hampstead, N.W., March 30.

The Use by Men of Science of an Artificial Language.

In Nature of March 30 (p. 155) the remark is made that "if it were possible to arrive at a general agreement [as to the use of an artificial language], even in one or two isolated sciences only, a real step in the diffusion of science would be made."

I desire to protest strongly against this view. Is it in the least likely that those Italians, Spaniards, Russians, Poles, &c., who will not now write their scientific papers in English, French, or German would write them in an artificial language? If they did so, while making themselves understood by a few *esperantists* or *idoists*, they would render themselves unintelligible to their own countrymen and all the rest of the world.

Science is sufficiently unattractive to the layman without being handicapped by an artificial language. Surely it is not too much to expect Poles and others to learn one of the three great modern languages—English, French, or German.

What is required is some organisation by which all important papers not published in English, French, or German shall be translated into one of those languages if it is found impracticable to *induce* the writers originally to publish them in one of the three great languages.

Bernard Hobson.

Thornton, Hallamgate Road, Sheffield, March 31.

A Wave Theory of Gravitation.

In the paper by Mr. C. F. Brush on a kinetic theory of gravitation, published in a recent number of Nature, a theory is suggested in which gravitational attraction is attributed to radiation pressure on the outsides of two gravitating bodies, so that "attraction" is rather a push than a pull. In fact, in outline the theory may be compared to Le Sage's corpuscular theory, in which the impinging atoms are replaced by a special type of æther wave exerting a pressure. That view is not altogether new.

I published an article in *The New Ireland Review* for August, 1907, in which that view was suggested as a speculation. Mr. Brush's theory differs in some of its details from the view I proposed, as, for example, the origin of the radiations. This view was suggested by Prof. Poynting's experiments on the "pressure of light." In my paper no mention is made of a very similar suggestion made some years earlier by Sir J. J. Thomson in a lecture delivered in Yale University in 1903, and afterwards published under the title of "Electricity and Matter." At the time of writing the article referred to I had not become acquainted with Prof. Thomson's suggestion. On p. 160 of the work just mentioned we read:—"We have seen in the first chapter that waves of electric and magnetic force possess momentum in their direction of propagation; we might therefore replace Le Sage's corpuscles by very penetrating Röntgen rays." The difficulties in the way of such a view are also indicated.

H. V. Gill.

Belvedere College, Dublin.

An occurrence of the Barium-felspar Celsian in North Wales.

Some finely crystallised mineral specimens from North Wales, kindly sent to me by Mr. G. J. Williams, H.M. Inspector of Mines, have proved on a preliminary examination to be the rare mineral celsian, hitherto recorded only from Sweden (by H. J. Sjögren in 1895). The beautifully developed monoclinic crystals are colourless and transparent, and extremely rich in faces. They are accompanied by other crystals of orthorhombic habit, which possibly represent a dimorphous form of barium-felspar. I am at present engaged on a chemical analysis of these crystals, and Mr. L. J. Spencer has undertaken to determine their crystalline form and optical properties.

Arthur Russell.

Swallowfield Park, Reading, March 27.

AN INTERNATIONAL VULCANOLOGICAL INSTITUTE.

At the International Geological Congress held last year in Stockholm, Signor Immanuel Friedlaender proposed the foundation of an Institute for Vulcanological inquiries. The matter was submitted to a commission which reported on it to a general meeting of the congress in a highly favourable manner. The object of the institute is to carry out continuously and systematically researches connected with volcanic phenomena. It is proposed to build a laboratory furnished with instruments for the measurement of the temperature of rocks and of gas at different points of Vesuvius; to analyse the gas from *fumaroles*, and to note seismic disturbances.

The existence of the present observatory at Vesuvius is known throughout all the world, but unfortunately at it continuous systematic researches have not been carried out, neither have they been carried out at any other volcano in the world. Thoroughly to accomplish what is proposed it is necessary to have an international union, not only for the purpose of collecting the necessary monies, but also to furnish the opportunity to men of science of all nations to make investigations at the new institute. The number of vulcanologists in Italy and in other parts of the world is few, a matter that can be easily understood, because there does not exist any permanent positions for specialists in this subject. The scientific importance of the undertaking does not require discussion. It has, however, a practical aspect. The enormous damage and loss of life by the eruptions of Krakatoa, Monte Pelée, and of Vesuvius in 1906, are fresh in our memory. Our present knowledge of volcanic phenomena is based upon intermittent observations, and therefore it is not sufficient to enable us to predict eruptions. Notwithstanding this, we now know that vulcanicity shows a series of regular phenomena. From this it appears that it is not only possible, but it is highly probable that after conscientious and exact registration of all the phenomena, science will shortly advance so far as to foresee more or less the time of occurrence of a new outburst. There exists another practical reason why we should study vulcanology. By the study of the activity of *fumaroles* and the metamorphosis of rocks, we may explain the origin of many minerals. Recent volcanoes are known to contain metalliferous minerals in course of formation, and a profound study of the phenomena of metamorphosis would therefore greatly increase our knowledge of the genesis of metalliferous deposits.

The organisation of the institute at its commencement will be as follows:—Signor Immanuel Friedlaender, who has already contributed 100,000 lire and an annual contribution of 10,000 lire, undertakes to collect subscriptions. These will only become payable if up to the first of January, 1912, the total sum promised for the construction and the plant reaches a minimum of 1,500,000 lire, and at the same time an income is guaranteed of not less than 50,000 lire. The legal position of the institute will at the outset be that of a society in which members with a right to vote have contributed at least 10,000 lire or pay 1,000 lire per annum. Members contributing less, so long as it is not under 25 lire per annum, will receive the printed papers and publications of the institute. The idea of an international institute of this description is by no means new. It has been proposed by Prof. Johnston Lavis, Prof. Mercalli, Prof. G. Platania, and five years ago Mr. Cool, a Dutch engineer, published a pamphlet on this matter. The project is already supported by sixty-two prominent names; twenty-five of these are Italians, nineteen are Germans, and three are English.

THROUGH PERSIAN DESERTS TO INDIA.[1]

DR. SVEN HEDIN'S latest book, describing the first section of his famous last journey to Tibet, in which he travelled overland to India, has at the present moment a special political and economic interest, in addition to its varied scientific contributions to our knowledge.

FIG. 1.—Salt Crust in the Kavir. From "Overland to India."

Deliberately avoiding the hackneyed caravan routes through the famous centres of ancient Iran, Dr. Hedin travelled from Teheran eastwards by way of the little explored salt deserts (Kavir), and through Seistan and Baluchistan, to Nuska, near Quetta, where he struck the Indian system of railways. He thus traversed a considerable part of the route over which it has just been proposed, by a group of Russian financiers, to construct a railway to link up the Russian railway lines with those of India, as an alternative, or rather as a rival, to the Bagdad line through Turkish territory to the Persian Gulf. By the proposed line through Persia the journey from London to Bombay is estimated to take less than a week at a cost of 40*l*., as against about 60*l*. for the existing sea route *via* Brindisi, occupying nearly twice that period, whilst the route by Bagdad will not, it is alleged, shorten the existing time very materially. Although Dr. Hedin does not refer to the proposed Persian line, the project for which has been put forward since his book went to the press, the country through which the line is to pass, and the geographical problems in regard to it, are graphically described therein.

Seistan, the most easterly province of Persia, bordering on both Afghanistan and Baluchistan, would be traversed by the line. It has for many years been a territory of great importance in Anglo-Russian politics, owing to its position, standing as it does midway between the Caspian Sea and the Persian Gulf. Although, at present, it is for the most part an arid and inhospitable desert, it is believed that the restoration of its former irrigation works will revive its pristine productiveness, when it was "the granary of mid-Asia"; so that it is regarded as having the possibilities of becoming a second Egypt. Its recovery from the clutches of the desert seems quite feasible. In this connection the process by which the former towns and villages, the traces of which are widespread, have been engulfed by the desert, is considered at some length. The chief factor appears to less climatic change than the cessation of human agency in staying the encroachments of the deserts. The general process of dessication which has been slowly going on in Asia since the Glacial period has proceeded so slowly that it appears to have advanced but little since Alexander's day, subsequent to which the country was much more populous than at present. The early religion of the country has been largely determined and fashioned by what we may call the aggressiveness of the desert. The effect which this has exercised on the minds of the inhabitants finds expression in the old Iranian belief of a beneficent creative power personified in the sun, and one hostile to mankind—Ormuzd and Ahzimrud. As evil associates of the latter are regarded the hot sandstorms, the mirage of the desert, the winter cold, miasmas, and noxious insects and snakes, &c. Hence the practical religious precepts ascribed to Zoroaster are the extermination of those harmful creatures, and especially to stay the ravages of the desert by the planting of trees, constructing water channels, sinking wells, and similar acts. The depopulation of these regions which has permitted the advance of the desert, has obviously been effected mainly by the ravages of devastating wars, intertribal blood-feuds, and the murderous raids of robbers. Under a settled and enlightened Government there seems a fair prospect of these deserts being to a great extent reclaimed, and even the desert of Gobi is not altogether hopeless.

FIG. 2.—Rush Boats on Lake Hamun. From "Overland to India."

At Trebizond, on the Armenian coast of the Baltic, the traveller falls again under the spell of the camel-caravan bells. "I never weary of this same monotonous sound, with its unchanging ryhthm, the ceaseless ding-dong, ding-dong, which I have heard so many times

[1] "Overland to India." By Sven Heden Vol. i., pp. xix+416+map; vol. ii., pp. xiv+357+map. (London: Macmillan and Co., Ltd., 1910.) Price, 2 vols., 30*s*. net.

before, and which awakes a longing for the Sabbath peace of unknown deserts and adventures in untraversed paths."

Not, however, until Teheran was passed does he reach the desert with which the book mainly deals, and on which the traveller camped day after day for several months, excepting at the few oases. In these latter it was occasionally possible to camp under the palms, where "the singing birds which twittered during the day are silent. The jackals start a melancholy serenade, and the soft plaintive song of the desert vibrates through the night." These oases are not entirely pleasurable. They are infested, especially by three venomous creatures: (1) a deadly snake, (2) scorpions, black and white, and (3) a poisonous tarantula spider, which lives out in the desert, but is attracted by the light of the camp fires.

Tebbes, and Dr. Hedin supports Sir Henry Yule's view that the famous Venetian passed here by the direct caravan route between Kuch-benan and Tebbes, in preference to the more modern view of Colonel Skyes and others, that it was by Naibend. It is interesting also to find that Polo's description of this desert "is as correct now as in the year 1272 A.D."

Dr. Hedin's alluring story of his exploration of great scientific interest and importance in itself, is also full of interest for the general reader as well. His numerous sketches and coloured illustrations are admirable and characteristic, but his photographs are exceptionally beautiful. They far surpass in artistic and technical excellence anything to be found in previous books on those regions. The publishers are to be congratulated on their splendid reproduction of these pictures, and on the attractive appearance gener-

Fig. 3.—The Village of Chahrdeh. From "Overland to India."

Wolves levy a heavy tax upon the village flocks. They are individually so well known to the shepherds that each of them has received names, and their haunts are well known. They even attack the camels: "they leap on to the camel's back and crawl down to his neck and tear his throat." Although it was reported that wild camels existed, "no one had ever seen them."

The northern limit of the date palm was found at Tebbes. Beyond this no palm-groves are met with, only a few single specimens in well-protected sites. At Tebbes, where, as throughout southern Persia, the palm supplies the staple food and is otherwise of inestimable service to man, it was calculated that there were 100,000 of the female tree—the male palms are very much fewer in number, and are called "*nehr*," the same word which is used to denote a stallion camel.

Marco Polo is believed to have passed through

ally of the book, which is certain to meet with a wide and hearty welcome.

THE PROBLEM OF INDUSTRIAL TRAINING.

DURING the last few years the feeling has been steadily growing that a large part of the money spent on elementary education is wasted for the want of a proper system of education in continuation schools, whether day or evening, which should prepare children for their future work. Unemployment, the decay of apprenticeship due to the changed conditions of labour, the increased number of occupations for boys and girls which lead to no definite future, and the bookish style of our elementary-school education, have been responsible for this feeling of unrest in the minds of all thinking persons. Some have suggested the reform of the elementary-school curriculum by making it more practical; others the rais-

ing of the school age to sixteen. There is much to be said in favour of both suggestions, and indeed the former is essential; but those who have thought over the problem feel that the raising of the school age will provide no remedy unless what may be called post-elementary or secondary education is directed into channels which will lead up to and adequately prepare children for their future work, whether of a professional, commercial, or industrial character. For professional and commercial occupations ordinary education has done something, but not enough; but for industrial occupations very little has been done except by classes which have been attended by students after a break of two or three years, during which time they have forgotten much that they had learnt at school. The need for some reform in our educational work and for an extension of education in continuation schools has been pointed out in papers read at the British Association meetings, in reports by the British Science Guild and the Consultative Committee of the Board of Education, and at conferences of education authorities.

The resolutions passed and the opinions expressed at the recent conference held at the Guildhall (see NATURE, March 2, p. 31), supported as they were by men and women representing all classes of the community, may be considered as evidence of a strong feeling that the time has come for some definite action to be taken. As an industrial nation we cannot afford to neglect the adequate preparation of our children for their future careers any longer.

Doubtless the commercial training required for professional or clerical occupations presents the least difficulty, because such training is more or less intimately connected with an extension of the curricula of higher grade and secondary schools with a definite objective, and generally there is no opposition to such education. The problems connected with the training of those who will take up occupations of a manual or industrial description are more difficult. As soon as such training is talked about there appears to be a general, though erroneous, fear that such training implies definite trade training, and that the market will be flooded with skilled workers; but an inspection of the work and methods of the schools to which we refer later on will show that this is unfounded. The object of these schools is to prepare those boys and girls who intend to enter various trades, so that they will have an opportunity of becoming skilled all-round workers rather than one-branch hands. The changed conditions of manufacture make some system of preparation in schools and technical institutions an absolute necessity.

In any general scheme, local trade conditions will have to be taken into account by local education authorities in arranging the curricula and in selecting the children suitable for the various types of schools. The number of pupils attending the various types of schools will ultimately be regulated by the laws of supply and demand. The training for industrial or trade occupations, if it is to be successful, must be given in special schools, such as preparatory trade schools, schools of arts and crafts, or technical institutes; and the instruction, whilst not neglecting the general education of the pupils, must include sound preliminary training in the theory and practice of the trades, whether of an artistic, scientific, or mechanical character.

There must be no attempt in such schools to supersede the training of the workroom, workshop, or factory; their aim should be to provide an all-round acquaintance, both theoretical and practical, with the particular trade or group of trades which the pupils will enter, and so to make up in part for the loss of those opportunities of learning formerly provided by the apprenticeship system in various industrial occupations.

A good beginning has already been made in this direction in London by the trade schools for girls, and at the London County Council schools and the Borough and Woolwich Polytechnics; there are similar opportunities for boys at the L.C.C. Paddington and Poplar Schools of Engineering, the Shoreditch Technical Institute for woodwork, the Borough Polytechnic Institute for engineering and metal trades, the Stanley School, the L.C.C. Central School of Arts and Crafts, and at the National Bakery and Confectionary School at the Borough Polytechnic Institute; there are others which might also be mentioned. There are also schools of various kinds in many of the principal towns of the country, such as Leeds, Liverpool, Bradford, and Wigan. In nearly all the schools mentioned the work is a full-time course, but railway companies and large employers of labour in various parts of the country have afforded facilities for their young workmen to attend classes for short periods in the daytime, to enable them to improve themselves both by study and practice in the trades in which they are engaged. Some problems in boy-labour in Government departments are also receiving attention, though much remains to be done.

Without considerable elasticity, no scheme of industrial training in schools and institutes can be thoroughly successful or completely satisfy the industrial and commercial needs of a practical nation such as ours; such training must be post-elementary; that is, must come, not under the regulations governing elementary schools, but under those governing technical schools and institutes, as otherwise there is a danger of limitations in various directions; it may be trammelled by religious questions, by large classes, by rigidity of syllabuses, and will probably suffer from lack of freedom in the choosing of suitable teachers for the work. The type of teachers employed in such schools is indeed one of the most important factors of success, and such teachers must be chosen rather for their special trade and workroom experience than for their academic qualifications. The cooperation of employers and foremen on advisory committees will also form an important feature in the work.

In conclusion, it should be remembered that trade prospers only with a nation which has an adequate supply of technically trained skilled workers. It is generally believed by those who have paid attention to the subject, and it is the opinion of those who can speak with authority, that the trades in which we hold our own are those in which apprenticeship or its equivalent is not yet dead. As the opportunities for apprenticeship in various trades are becoming fewer and fewer, something in the way of a substitute is necessary, and this can be supplied by wise modification and extension of our educational system in the direction of industrial training.

C. T. MILLIS.

DAYLIGHT SAVING?

ON the face of it, the proposed Daylight Saving Bill is distinctly good. For a certain season in the year the clerks in the City of London will get one more hour to spare before the sun goes down. As a result of this they will have more time for the enjoyment of fresh air, more time for outdoor amusements, more time to learn rifle shooting, gain more health, become happier men, and enjoy other benefits. If this is really the case, then the clerks in the west of England, who have for years and years enjoyed 33 per cent. more evening sun than those in the eastern counties, ought to exhibit at least some trace of the benefits which accrue from an extra dose of

daylight. Possibly the inhabitants of Cornwall are really more happy and bright, vigorous and enterprising, than the inhabitants of Kent; but is this really a fact?

Next, where does happiness come in if on a cold spring morning you have to get up one hour earlier? What will the wife and children say to the arrangement? Turning out too soon on frosty mornings, groping about at 4 a.m., to find a box of matches to light the fire, may give rise to domestic irritation, bronchial catarrhs, and other illnesses. Thousands upon thousands of workmen in the north of England, to be at work at 6 a.m., when it is really 5 a.m., will have to disturb their households at the time specified. At the commencement of April a man will get up in the dark, walk to his factory in the dark, and commence work by artificial light. Whatever light and fuel has been saved on the previous evening in the house or workshop will be spent in the dark hours of the early morning. For about six months, or 182 days, which I believe is the period over which the new-fangled time is to extend, men will frequently have to rise before the sun; nature will be asleep, but he must be awake and run counter to Divine intentions. As matters now stand during this period workmen get up on 127 days *after* sunrise. The new Bill will reduce the number of these occasions to 52. He will have been robbed of his morning daylight, and have 75 extra days of morning darkness.

There is not so much daylight saving in the Bill as may popularly be supposed. It gives an hour in the evening, but cuts off an hour in the morning. Will a darkness creating Bill please the British workman?

When to give pleasant afternoons to the few who always go to work in daylight, the workmen in this country, in their trains and trams, and on their "bikes" or on their feet, take to blundering about in the morning dark, it suggests an increase in the number of accidents, more litigation, more illnesses, and more funerals. Doctors and lawyers will have more employment, and insurance companies may raise their rates.

Many medical men are supporting this proposed alteration, and have emphasised the benefits that may accrue from the greater amount of sunlight that people will enjoy if these changes are adopted. Obviously, of course, those requiring more sunlight can, if they will, get up earlier in the morning without any dislocation or changes in standard time. But to compel all workers to get up an hour earlier some months of the year may have effects upon the health quite other than seems to be supposed. Man is largely the creature of habit, and the habits acquired by long usage cannot be broken through suddenly without ill results. When early in April the time is suddenly altered, the result will be that for some days, possibly weeks, workers, clerks, and all others compelled willy-nilly to accommodate themselves to this incompletely considered scheme will find themselves at work, still half asleep, with serious results to their own efficiency, to their own health, and their employers' pockets.

In addition to all this, as I have before said, England, by destroying the time standard of the world, will have gone back on her bargain with other nations, and her steamship and other communications with other countries will have been disturbed.

The defenders of the Bill admit that it has its defects, but they do not point out how these are to be remedied.

To say that different parts of the United States keep different times, and that Cape Colony has found the adoption of the 30th meridian a boon, has nothing whatever to do with the question at issue. These and other countries have adopted a *fixed* time and adjusted their clocks to the Greenwich standard and not to a time that is altered at least twice a year. In these circumstances why references to the United States and Cape Colony have been brought forward I do not understand. The unthinking public might infer that because certain countries have altered their clocks there can be no great harm in altering ours. If this was seriously intended, these arguments are a reflection upon their authors, and indicate that certain reasons for the adoption of the Daylight Saving Bill rest upon curious foundations.

Some years ago, with the assistance of the Foreign, Colonial, and India Offices, I had occasion to inquire into the varieties of time kept by all accessible communities of the world. The only people I remember that have a shifty time are Mahomedans and savages, and it is now suggested that we should take a step downwards and join their ranks.

Astronomers and navigators are, however, to be left in peace. I imagine that those who desire to save daylight recognise that a movable time system might lead to shipwreck and to difficulties in the construction of nautical almanacs, and other astronomical work. If these departments are to be freed from the new arrangements, why should not the same freedom be given to meteorology and all other sciences in which it is necessary to have time observations comparable with those of other countries?

The simplest solution to the whole question would be to commence work one hour earlier in the morning and not confuse ourselves and others by altering the clock. In Japan thousands of schools open in the summer time at 7 a.m., Government offices open at eight and close at two; and what is done in Japan is done in other countries. Surely it is possible for business houses in this country to do something similar.

JOHN MILNE.

THE DESTRUCTION OF LOCUSTS.[1]

A REPORT recently received from the South African Central Locust Bureau bears testimony to the strenuous efforts which have been made during the last four years by the various Government entomologists and others in the systematic collection and tabulation of data regarding the more important phases in connection with the destruction of crops by migratory and other locusts. We congratulate the editor and his colleagues on the most excellent results which they have achieved, and the thanks of the country are also due to them for the valuable assistance which they have rendered to the agriculturists in Cape Colony and elsewhere by the successful methods which they have adopted in checking the ravages of these destructive insects.

In the introduction of the report we are informed that the South African Central Locust Bureau was formed in 1906 through the instrumentality of the Earl of Selborne, then his Majesty's High Commissioner in South Africa. His Excellency saw clearly that several colonies and territories under his supervision would benefit mutually if each were kept informed in regard to locust occurrences and to locust destruction, and measures in the territory of its neighbours, and that it was highly desirable in order that the pest might be intelligently combated, that the origin and movement of invading swarms be elucidated. The 1909 campaign cost the Government a

[1] Fourth Annual Report of the Committee of Control of the South African Central Locust Bureau. Respectfully submitted by the committee to the several Governments supporting the Bureau. Edited by Chas. P. Lounsbury, Government Entomologist, Cape Town, Cape of Good Hope. Pp. 59+15 maps. (Cape Town: Cape Times, Ltd., Government Printers, 1910.)

sum approximating 4000*l.*; even so, it is impossible to estimate its worth to the country, either directly or indirectly; but the editor thinks the saving effected by the campaign may be safely set down as at least a hundredfold. As first of all there is the direct benefit which accrues from the saving of the crops, and, second, the destruction of vast armies of locusts, which will materially lessen if not entirely prevent the recurrence of swarms during the succeeding season.

In comparing the 1909 visitation with that of previous years, it is stated that it was probably the most severe one which has been experienced since 1893, as altogether no fewer than 15,306 swarms were accounted for and tabulated in the monthly returns. These do not, however, take into account the numerous swarms destroyed by the Railway Department or in those districts where there was no locust officer.

The term swarm is of exceedingly vague significance and it is quite impossible to estimate the average size of those which were destroyed. But these may be said to have varied in size from those covering a few square rods to others of such magnitude that they covered hundreds of acres. In the initial stages of the 1909 invasion the insects came down in immense swarms from the Kalahari Desert in March, and subsequently mighty swarms swept the country clean to the coast of the Indian Ocean between Port Elizabeth and East London, the females depositing their eggs more or less all the way from the desert to the sea, where they covered an area of country about 200 miles in width.

The most highly favoured of all the agents used in the destruction of locusts is a mixture of arsenite of soda and treacle. In preparing this the custom is to dissolve 200 lbs. of the arsenite in about 15 gallons of boiling water and then to add water until the bulk is 20 gallons. Half a gallon of this is then poured into an iron drain, specially manufactured for the purpose, and a gallon of the treacle or syrup added; the whole is then thoroughly mixed, the drumhead fixed, and the material is then ready for transport. The dilution of the poison recommended by the department is one part to 66 of water for newly-hatched locusts ("Voetgangers"), and one part to 50 when the insects are about a fortnight old. Mr. C. P. Lounsbury points out, however, that no single means of destruction can be recommended for use in all circumstances, and that spraying with either the arsenical poison or with a soap solution is applicable only where water is available. The soap emulsions make the cheapest spraying solutions for killing the locusts *by contact*, but if the solution is too highly diluted with water the insects may be stupefied for a few hours and finally recover. On the other hand, the arsenical preparation acts as a stomach poison and kills them more or less quickly, according to the strength at which it is used. When poison is used it is lightly sprayed around or over the swarms, or in front of them if they are on the move. This preparation has unfortunately a deadly effect upon the vegetation, and cattle should not be allowed to graze upon the sprayed areas until after a good rain, or after the dead herbage has been fired. Whole areas of crops under cultivation must not be sprayed, and in such circumstances poisoned baits may be used with excellent results, and the most marked feature of the recent work of locust destruction was due to the vastly increased use of such "baits." Various materials are used, but finely-chopped green forage is claimed to be the best. As a substitute bran, mixed with the poison, is also strongly recommended by the officer in charge of the Caradoc district, but it is thought that this may have a deadly effect upon small birds, and is not generally advocated.

One of the most interesting chapters in this report is that which deals with locust-eating birds, the species referred to being the white stork (*Ciconia alba*), though other members of the pelargi are evidently included, and small pratincoles (Limicolæ). It is stated that these birds practically cleared the country of the swarms of locusts that had escaped being poisoned, and that they are the leading factors in the natural control of these pests. This is not the first occasion that the bureau has published information regarding this destruction of locusts by birds; it may be recalled here that information was given in the previous report, in which it was stated that the swarms of locusts which occurred in the country bordering on the Kalahari were practically exterminated by them.

TOTAL ECLIPSE OF THE SUN, APRIL 28, 1911.

Although the eclipse which is due to occur on Friday, April 28, 1911, will only be visible along a narrow track extending from the south-eastern coast of Australia to the islands about Samoa, it has attracted a strong contingent of both official and private observers. In spite of the comparative difficulty of access, it was considered that this, being the last of the series of long-duration eclipses for some years to come, warranted a special attempt being made to secure the important observations, spectroscopic and topographic, which can as yet only be efficiently made during the period of eclipse.

After very careful consideration of all possible situations, most of the parties have proceeded to a small coral island, Vavau, one of the Friendly Group in lat. 18° 39′ S.; long. 173° 59′ W. Three English parties have arranged to observe the eclipse in the vicinity of Neiafu, the chief town of Vavau. The constitution of these, with their instrumental equipment, is as follows:—

(1) *Government Expedition from Solar Physics Observatory.*—Dr. W. J. S. Lockyer, in charge of this party, and accompanied by Mr. F. K. McClean, left London on February 3, 1911, with the necessary gear, and journeyed to Sydney by the Orient s.s. *Otway*. From there the instruments were transhipped to H.M.S. *Encounter*, of the Australian Squadron, and the expedition started for the Friendly Islands on March 25. Their equipment consists of:—

(*a*) *6-inch prismatic camera*, 7 feet 6 inches focal length, with four large objective prisms of 45° angle. With this instrument it is hoped to photograph the spectrum of the sun's atmosphere at second and third contacts, and also to obtain several records of the coronal spectrum during totality. This will be used in connection with a 12-inch siderostat.

(*b*) *Concave Rowland Grating Spectrograph*, of 10 feet radius of curvature, arranged as a slit spectrograph for the first-order spectrum. A special plate holder has been provided, carrying six celluloid isochromatic films, 24 inches long, bent to the curvature of the focal curve. A Cooke photo-visual triple objective of 30 feet focal length, receiving light from a 21-inch siderostat, will form an image of the sun about 3½ inches diameter on the slit plate. An endeavour will be made to photograph the spectrum of the cusps and of the corona during totality.

(*c*) *Cooke Coronograph*, 4 inches aperture and 16 feet focal length.

(*d*) *De La Rue Coronograph*, 4⅜ inches aperture and 8 feet focal length.

(*e*) *Doublet Coronograph*, 5 inches aperture and 30 inches focal length.

(*f*) *Doublet*, 6 inches aperture and 48 inches focal length.

Two small spectrographs will also be used with Thorp replica diffraction gratings placed in front of the camera lenses. To feed these instruments with light two siderostats, of 21 inches and 12 inches aperture respectively, and a coelostat of 16 inches aperture, have been taken by the expedition. On

arrival at Sydney, this party will be joined by several gentlemen who have had experience of eclipse work with Mr. F. K. McClean in Flint Island (1908) and Tasmania (1910). These are Messrs. J. Brooks, W. E. Raymond, and H. Winkelman.

2. *Expedition from the Joint Permanent Eclipse Committee.*—This party will be under the charge of Father A. L. Cortie, S.J., from Stonyhurst Observatory, who will be assisted by Mr. W. McKeon, S.J., and Father E. F. Pigot, S.J. Father Cortie's expedition also travelled by the *Otway* from London, and proceeded to Varau on board the *Encounter*. The equipment is as follows:—

(1) Coronograph of 20 feet focal length.

(2) Coronograph of 4 inches aperture.

(3) Coronograph of 4 inches aperture and 34 inches focus.

(4) 4-prism quartz train spectrograph for recording the ultra-violet spectrum of the chromosphere and corona.

(5) 6-inch Dallmeyer portrait lens arranged as a prismatic camera with a 7-inch objective prism of 42° angle.

3. A private expedition in charge of Mr. J. H. Worthington, who has had a special equipment made for this eclipse. His main instruments will include:—

(*a*) Quartz-rocksalt spectrograph of $2\frac{1}{8}$ inches clear aperture and 4 feet focal length. With this will be used two objective prisms of quartz, 60° angle and $2\frac{1}{2}$ inches high. The length of spectrum given by this combination is 8 inches from D to λ 2600.

(*b*) $3\frac{5}{16}$-inch coronograph with amplifying lens giving an equivalent focal length of 20 feet.

(*c*) $2\frac{3}{8}$-inch coronograph of 4 feet focal length.

(*d*) 3-inch portrait lens coronograph, 24 inches focal length.

Arriving at Vavau early in April, the various parties will have ample time to get their various instruments into the delicate adjustment which is necessary, provided, of course, that they are not seriously hampered by inclement weather. A telegram received from Sydney brings the welcome news that the officers and men of H.M.S. *Encounter* are enthusiastic in their anticipation of helping in the work of the various expeditions, and this augurs well for the success of the eclipse observations if good, clear weather is experienced.

The eclipse occurs at Vavau about 9.15 p.m. G.M.T. on Friday, April 28, totality lasting 217 seconds, with the sun at an altitude of about 43°.

Charles P. Butler.

NOTES.

A committee has been appointed for the purpose of raising in Amsterdam a suitable monument to the memory of the late Prof. van 't Hoff.

Sir J. J. Thomson, F.R.S., has been elected a correspondant of the Paris Academy of Sciences in the section of physics.

The Queensland Government recently appointed Dr. R. Hamlyn-Harris as director of the Queensland Museum, and has issued to him instructions to reorganise and put the museum on a próper footing.

Since the so-called "Daylight-saving" scheme was first put forward, we have pointed out that a change of custom as to the hours of opening of city offices would secure the better use of daylight without legislative action. We are glad, therefore, to see the announcement that in certain departments of the Board of Education the officials arrived at their offices on Monday at 9 a.m. instead of at 10 o'clock, and left at 4 p.m., an hour earlier than usual. The experiment proved such a success last year that the Board of Education authorities have decided to give it a wider trial during the forthcoming summer.

It is proposed, in memory of the late Dr. Louis Olivier, founder of the *Revue générale des Sciences*, to publish a book, of from 250 to 300 pages, containing contributions from eminent men of science and letters who knew M. Olivier. The volume is to appear next August for the anniversary of the death of M. Olivier, and will be accompanied by a booklet containing his portrait, a biographical sketch, and a bibliography of his works. Subscriptions of 20 francs will secure a copy of both publications on ordinary paper, and 50 francs will entitle to copies on Japanese paper. Subscriptions may be sent to M. Louis Brunet, treasurer of the committee, 18 rue Chauveau-Lagarde, Paris.

The Decimal Association has issued a circular with reference to the Colonies and the metric system of weights and measures. The most recent instance of the adoption of the metric system by a British colony is that of Malta, where an Ordinance has been passed making the system compulsory as from January 1 next, or such later date as the Governor may fix. It is understood by the Decimal Association that the question of the introduction of the metric system throughout the Empire will be brought forward by the Australian representatives at the forthcoming Imperial Conference. Accompanying the circular is an interesting summary of official reports on the metric system by Mr. J. H. Twigg, late of the Bengal Civil Service.

The noteworthy flight of Lieuts. Erler and Markenthun from Berlin to Hamburg, and thence to Bremen, has provided a remarkable example of the immediate military value of the aëroplane. The officers started on March 28 soon after eleven o'clock, reaching Hamburg, 142 miles distant, about half-past six. Two halts, each of about two hours' duration, were made, one at Döllen in Mecklenburg, owing to the overheating of the motor, and the second at Ludwigslust. A wireless message was sent from the machine *en route*, which was received at Nauen, near Berlin. The altitude maintained—492 feet to 984 feet—was comparatively small for military purposes, and the flight was aided by a slight following wind. The next day the officers continued the journey to Bremen, covering the distance of 73 miles in a continuous flight of 1h. 15m., aided again by a following wind. The machine used was a biplane built to the designs of the military authorities, with the passenger's seat placed directly behind that of the pilot, but at a higher elevation to enable the observer to obtain an uninterrupted view in all directions. A dual control was fitted, allowing the observer to take charge in the event of the pilot becoming incapacitated from any cause.

A Central News message from Christchurch (N.Z.) on April 1 states that the *Terra Nova* has arrived safely at Port Lyttelton from the Antarctic. During the meeting of the British party with the Amundsen Expedition cordial greetings were exchanged. As already announced, the *Terra Nova*, while following the Great Ice Barrier from the direction of King Edward Land with the view of landing the eastern exploration party somewhere near what was formerly known as Balloon Bight, found the *Fram* in the Bay of Whales. Captain Amundsen's sole object for the present is to reach the South Pole by way of the Beardmore Glacier, but he hopes, after having done so, to carry out the programme of Arctic exploration originally drawn up by him. His equipment includes 116 Greenland dogs and a sufficient number of sledges and skis. The *Terra Nova* on her return to McMurdo Sound left a message in the *Discovery* hut announcing the meeting with Captain Amundsen, and this message Captain Scott will find when he returns from his depôt-laying expedition

in the south. The *Fram* is going to Buenos Aires, and will return to the Barrier in 1912.

THE Prehistoric Society of France will hold its seventh meeting at Nîmes on August 6–12.

Two lectures to engineers, on steel, will be given at the Institution of Mechanical Engineers on Tuesdays, April 11 and 25, by Dr. Walter Rosenhain, of the National Physical Laboratory.

THE Selborne Society has just issued a new prospectus which is well illustrated from photographs by members of the society, and includes pictures by several of the pioneers in nature photography. The prospectus contains a long list of branches and junior branches, with the rules of the society; copies can be obtained by prospective members on application to the honorary secretary at 42 Bloomsbury Square, W.C.

THE death is announced from Rotterdam of Pieter Cornelius Tobias Snellen, the distinguished entomologist, at seventy-seven years of age. A notice in *The Times* of April 5 gives the following particulars of his work:—Snellen devoted his attention almost exclusively to the Lepidoptera, and was one of the founders of the Entomological Society of the Netherlands, in the Transactions of which he published a valuable series of articles both on Dutch and foreign Lepidoptera from 1857 onwards. His work on the Lepidoptera of Holland, published in three volumes in 1867 and 1882, under the title of "Vlinders van Nederland," is the standard work on the subject, and is a model of completeness and accuracy. In addition to his European collection, Snellen brought together a very valuable foreign collection with the assistance of his friend M. C. Piepers, and other Dutch Colonial officials, and on materials thus acquired he based valuable papers on the Lepidoptera of West Africa, Java, Celebes, &c., and he also contributed a long paper on Lepidoptera to Veth's "Midden-Sumatra."

SIR CASPAR PURDON CLARKE, formerly director of the South Kensington Museum, and afterwards director of the Metropolitan Museum of Art in New York, died after a long illness on March 29. Sir Caspar acquired a considerable reputation by his knowledge of Eastern art, of which he was an enthusiastic and earnest student. On behalf of the South Kensington Museum he made several expeditions to the East for the collection of objects of Indian and Persian art, and the very remarkable display of Indian art and Indian architecture, which was one of the most attractive features of the Indian and Colonial Exhibition, 1886, was almost entirely due to the result of the journey which he made the previous year for the collection of suitable examples. After serving at South Kensington in various capacities, he followed Sir Philip Cunliffe-Owen as director of the museum in 1896. Nine years later—in 1905—he was attracted by the liberal offers of the authorities of that museum to the Metropolitan Museum of Art in New York. Illness compelled his abandonment of this post last year, and since his return to England he had been in very failing health.

THE Lötschberg Tunnel through the Bernese Alps was pierced early in the morning of March 31. It has taken four and a half years to bore the tunnel, and it will be another two years before it is open for traffic. The length is rather more than 9¼ miles, and the tunnel ranks third among the great Alpine tunnels. The Simplon is 3¼ miles longer, and the St. Gothard only about a quarter of a mile. One end of the new tunnel, which derives its name from the Lötschen Pass under which it runs, comes out at Kandersteg, in the Bernese Oberland, the other at Goppenstein, 17½ miles from Brigue. The Lötschberg Tunnel differs from the other Alpine tunnels in not being straight, there being three curved lengths of 872 yards, 1222 yards, and 350 yards respectively, amounting in all to about one and one-third miles. This curved course was not part of the original plan, but was necessitated by the accident of July 24, 1908, when the Kander River was tapped and the water rushed into the workings, carrying with it a mass of rock, and killing twenty-five workmen. In consequence of this catastrophe, the total length of the tunnel was increased from 13,735 metres to 14,536 metres, or nearly half a mile. On the approach lines nearly one and a half millions sterling are being spent, while the tunnel itself was to cost 2,000,000*l.* To this sum, however, must be added the extra expenditure, amounting to 80,000*l.*, involved in lengthening the tunnel in the manner described. The chief difficulties encountered have been the hardness of the granite during a great part of the tunnel's course, which has involved heavy expenditure for blasting material, and the high temperature on the south side, which sometimes rose to more than 90° F.

THE Corrosion Research Committee of the Institute of Metals is now actively engaged in preparing for an elaborate series of investigations into the causes of the corrosion of brass condenser tubes. A special condenser is being constructed, which will contain forty-eight tubes, twenty-four of these being made of commercially pure brass, the remaining twenty-four tubes being made from brass containing a single selection from the following:—*lead*, tin, aluminium, manganese, or other materials at the discretion of the committee. Experiments will be made with various water speeds in the ratio of 0 : 1 : 2 : 3 : 4, speed 2 being an average speed used in practice. The circulating water to be used will be obtained from deep water at Formby, off Liverpool, in the first instance, and the plant for the corrosion research will be installed in the University of Liverpool, where the experiments will be under the direct supervision of Mr. G. D. Bengough. It is expected by the committee that the research will occupy many months before any definite conclusions can be reached, and it will undoubtedly be costly. An appeal was recently made by the committee for funds to carry on the research, and in response to it the total amount received was 242*l.* This is sufficient to enable the research to be commenced; but if the work is to be carried on properly the expenses will probably amount to not less than 300*l.* per annum. It is therefore hoped that additional donations to the Corrosion Research Fund will be speedily forthcoming. Donations should be sent to Mr. G. Shaw Scott, secretary of the Institute of Metals, at Caxton House, Westminster, S.W.

THE annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday, May 11 and 12, commencing each day at 10.30 o'clock a.m. On the Thursday morning, the Bessemer gold medal for 1911 will be presented to Prof. H. Le Chatelier, and the Andrew Carnegie gold medal for 1910 will be presented to Mr. Félix Robin (Paris). The awards of the Andrew Carnegie research scholarships for 1911 will be announced, and a selection of papers will be read and discussed. The annual dinner of the institute will be held in the evening in the Connaught Rooms, Great Queen Street, W.C. On Friday, May 12, a further selection of papers will be read and discussed. The autumn meeting of the institute this year will, by the invitation of the Associazione fra gli Indus-

triali Metallurgici Italiani, be held at Turin, Italy, and an influential local reception committee has been formed, under the presidency of Mr. G. E. Falck, president of that association, to carry out the necessary arrangements. The meeting will commence on October 2, and with the subsequent tour organised in connection therewith will occupy about fifteen days from the time of leaving London until the return

In the report of the Royal Zoological Society of Ireland for 1910, the council states that, in spite of the bad weather of last summer, the money taken at the gates has not shown any serious decrease, this being largely due to an increase in the number of sixpenny admissions. On the other hand, the receipts from subscriptions and entrance-fees were distinctly lower. The lions continue to form one of the features of the menagerie, where they are now represented by twenty-one individuals. Lack of funds prevented extensive purchases during the year, but among the additions made in this manner attention may be directed to a young reindeer. The losses by death were serious, and an appeal is made for funds to establish and equip a hospital, by the aid of which it is hoped the mortality may in future be reduced.

In a paper published in the February number of *The Victorian Naturalist*, Mr. J. A. Kershaw shows that the Australian eel (*Auguilla australis*) migrates to the ocean for breeding purposes in the same manner as its European relative, and that in turn the young elvers ascend the rivers until they find suitable dwelling places. As in Europe, these eels, when prevented by dams or on account of living in land-locked lakes or ponds, from reaching the sea by a direct route, will travel during freshets across flooded grass for long distances. Similarly, the elvers in Victoria not uncommonly ascend the streams in large "fares," when, in case of a barrier intervening, they make their way over comparatively smooth surfaces of rocks, as is well shown in the photographs illustrating the paper.

To the March number of *The Zoologist* Prof. McIntosh, of St. Andrews, contributes a sketch of the organisation and habits of the toothed whales. At the commencement the author endeavours to perpetuate the mistake that the "gigantic" mammoth was larger than living elephants, while later on he states that the teeth of the sperm-whale have been asserted to serve as a lure for prey, whereas he should have said the white lining of the mouth. He also asserts that the limbs of zeuglodonts are unknown, and implies that these animals are restricted to America. This being so, it is not surprising to find that he appears to be unfamiliar with the researches of Fraas, Dames, Stromer, and Andrews into the organisation of zeuglodonts, and the discovery of their apparent descent from creodonts. It is remarked that we are still in almost complete ignorance with regard to the slumber of cretaceans—if indeed they sleep at all; and an interesting reference is made to the belief of whalers that rorquals, after filling their lungs with air to the utmost extent, can remain in a quiescent condition beneath the surface of the water for eight or ten hours at a stretch.

The scheme for the administration of the 40,000*l.* granted from the development fund to the Board of Agriculture and Fisheries for the encouragement of light-horse breeding, is now in full working order. It will be remembered that the objects of the grant are five-fold, namely, the award of premiums to stallions, awards for the purchase of half-bred working brood-mares to be stationed in selected districts, free nominations for mares to be served by approved stallions, the purchase of stallions for resale, and the voluntary registration of stallions. The awards to stallions are to take the form of King's premiums and the Board's premiums, and in both cases owners will have to agree to their stallions serving not fewer than fifty mares if required, exclusive of those to which a free nomination has been given. In no case will service-fees be paid for more than ninety mares in any one year. It is estimated that about 200 working brood-mares can be purchased annually, and the free nominations for mares are expected to reach about 1400. By the purchase of stallions it is hoped to keep in the country a number of animals which would otherwise go abroad. One of the difficulties will be that the grant will increase the supply of hunters, cobs, &c., without creating a new market for this kind of stock, the demand for which is decreasing. The answer to this depends in some degree on whether the War Office is prepared to raise the stock of army horses to a war-footing.

In *Meddelelser fra Kommissionen for Havundersögelser*, Serie Fiskeri, Bind III., No. 8, Dr. A. C. Johansen gives a summary account of the recent investigations on plaice and plaice fisheries in Danish waters, treating separately of the fisheries in the North Sea, the Skagerak, and the northern Kattegat. The present memoir gives a very useful and comprehensive summary of the previous reports which have been issued on the same subject. It includes an account both of the market statistics of plaice landed and of the special scientific investigations and experiments which have been carried out. The market conditions in Denmark are exceptional, owing to the fact that the chief demand is for fish which are landed alive. This influences the method of fishing, the plaice being caught in seine nets instead of in trawls. The fish thus caught are for the most part alive when captured, and as there is a size limit (25·6 cm.) below which they are not allowed to be landed, and the fish under this size are returned to the sea, the actual destruction of small fish is insignificant. It appears that since the introduction of the size limit the Danish plaice fisheries in the North Sea have increased, and the report speaks in favour of an international size limit for plaice for all countries carrying on fisheries in the North Sea.

The Legislature of Montana, since January 20 last, has introduced and enacted into a State law a measure that converts the famous "Hell Creek Bad Lands" country into a State game preserve. Primarily it is for the benefit of the prong-horned antelope, mule deer, and mountain sheep still surviving in that wild and picturesque region; but it is reasonably certain, also, that in the future a nucleus of American bison will be added. The region fronts on the Missouri River, and it lies about 100 miles north by west of Miles City. The total area of the preserve is about 100 square miles. About three-fourths of it consists of very deep and rugged bad-lands, made by the waters of Snow Creek, Hell Creek, and other streams. The remaining fourth of the tract contains some high-level grass lands that can support a herd of perhaps a thousand bison. On the eastern side of the preserve lies the fossil region, now known widely as "the Hell Creek formation," discovered in 1902 by Messrs. W. T. Hornaday and L. A. Huffman, out of which have come the great lizard (*Tyrranosaurus rex*) and the giant three-horned dinosaur (*Triceratops brevicornis*). The new preserve contains a small band of mountain sheep. It is intended, eventually, to ask Congress to make Snow Creek a national preserve.

In a recent issue of *The Agricultural News*, the journal of the West Indian Department (vol. ix., No. 223), attention is directed to the possibility of growing Castilloa rubber in Jamaica. It is considered that *Castilloa guatemaltica* is better suited to the local conditions than *C. costaricana*, but it is stated that a drought-resisting Castilloa occurs on the Pacific side of Costa Rica which might prove useful, and is to be tried. The tree should be planted as a separate crop, and not as a shade crop for cacao, if the best results are desired.

The report on the Local Department of Agriculture at Barbados, 1909–10, deals mainly with sugar-cane and cotton experiments. There has been a falling off in the area planted in cotton owing to various discouragements, which, it is stated, would have been greater but for the efforts of the Department. The production and introduction of useful food crops has been continued, with promising results, and a beginning has been made with an export trade to Great Britain. Bananas have been shipped here, and also mangos and Avocado pears, but unfortunately some of the two last crops reached London in bad condition. Sweet potatoes and yams were also sent; from the experience gained it is clear that much has to be learned in regard to time and method of shipment, &c.

Dr. Theiler, of the Transvaal Agricultural Department, showed some time ago that redwater is caused by *Piroplasma bigenimum*, and devised a system of inoculation that has proved very successful in rendering immune the South African cattle. But both in the Transvaal and in Cape Colony considerable trouble has arisen when imported cattle have been inoculated, so many as 33 per cent. of the animals being lost in the experimental trials. The problem is discussed in a recent issue of *The Agricultural Journal of the Cape of Good Hope* (No. 4, vol. xxxvii.) by Mr. R. W. Dixon, who recommends that only young animals less than a year old should be imported if possible, as these resist the ill-effects of inoculation better than older animals. It is further recommended that the importation should be in winter or early spring, at which time tick infestation is in abeyance, and redwater, whether natural or artificially induced, is always milder in cold than in warm weather.

The bush-fire problem in thinly populated countries is discussed by Mr. T. S. Marshall in the Journal of the Department of Agriculture of South Australia (vol. xiv., No. 3). Right through Australia, he states, millions of acres of forest country occur in which many of the trees are ring-barked, others are hollow to the core, numberless dead trees, inflammable as tinder, lie on the ground, while the thick grass and undergrowth become very dry. The fires are started through careless throwing down of burning wax matches—surely the most dangerous of all matches in a forest—by neglect of camp and other fires, by sparks from engines, &c. As a safeguard, breaks are prepared round farm holdings by ploughing a strip one, two, or sometimes more chains wide all round, and keeping it carefully free from growth. In better settled districts brigades are organised and provided with specially constructed carts for sprinkling the ground in front of the fire, and so making a break, or putting out logs and fences that have begun to burn.

The soy bean (*Soja hispida* or *Glycine hispida*) has during the last two years come into prominence as a cattle food in England, and a certain number of experiments have been made to compare it with linseed and with cotton-seed cakes, which have hitherto been the standard purchased foods employed here. A report on two experiments made by Mr. W. Bruce, of the Edinburgh and East of Scotland College of Agriculture, has recently been issued, and the results indicate that soy-bean cake may be inferior to linseed cake for purposes of fattening bullocks. As Mr. Bruce points out, however, the result cannot be considered final. Feeding experiments are liable to many sources of error, and it is not unusual to find that a result obtained in one experiment is not confirmed on repeating the trial elsewhere. Whether the soy-bean cake proved less profitable than the linseed cake is not clear; in one of the two experiments it proved the more expensive food for making flesh, but, in the butcher's opinion, the flesh was worth more.

In *The Agricultural Journal of British East Africa* (vol. iii., part ii.), published by the Agricultural Department, Nairobi, is an article on the rainfall of Nairobi giving diagrams, but, unfortunately, few or no figures, to illustrate various phenomena indicated by the records from June, 1899, to December, 1909. The rainfall is at a maximum in April, when it is 8 inches on the average, though the amount has been so high as 16 and so low as $1\frac{1}{2}$ inches; it then falls, and during the months July, August, and September it averages less than an inch a month, the variation being from drought to 2 inches. It then rises to November, when there is a second maximum at 5 inches, the variation being from less than 2 to nearly 8. According to a native tradition, the rainfall runs in cycles of nine or ten years, each of which cycles terminates with a drought. The records have not gone on long enough to test the validity of this tradition. In another article attention is directed to the loss of power in internal-combustion engines at high altitudes. The writer states that he is working engines at an altitude of some 5000 feet above sea-level, and discusses methods by which the loss, due to diminished atmospheric pressure, may be reduced.

A contribution to the morphology of the Nyctaginaceæ, by Dr. H. Fiedler, published in Engler's *Botanische Jahrbücher* (vol. xliv., part v.), is concerned chiefly with the inflorescence modifications and floral diagram variations, from which the author draws conclusions as to the phylogenetic sequence of the included tribes and genera. The tetracyclic character of the flower with two staminal whorls, characteristic of the Centrospermæ, is confirmed, and evidence for two or more lines of development in the family is adduced.

Two useful compilations by Mr. P. C. Standley relative to the botany of New Mexico are published in vol. xiii., part vi., of Contributions from the United States National Herbarium. The first is an annotated list of type species from New Mexico, together with their localities; to these is added a summary of the itineraries of early collectors, a descriptive list of type localities, and a map of the territory of New Mexico on which the localities are marked. The number of species enumerated is 690, of which one-fifth were collected in the vicinity of Santa Fe, chiefly by A. Fendler in 1847. The second article is a bibliography of New Mexican botany.

A report by Mr. H. N. Thompson, the conservator of forests in southern Nigeria, on his tour through the western districts of Meko and Shaki, provides the subject of a publication by the legislative council of the colony. The forests inland are chiefly open savannah or park-like, in which deciduous-leaved trees predominate; in moist situations along the banks of streams they become denser,

and contain more evergreen species. Extensive areas of the so-called black cotton soil form a special feature that is rare in tropical West Africa. *Pseudocedrela Kotschyi* is the most important tree, both in quantity and quality; *Lophira alata*, the West African oak, and *Pterocarpus erinaceus* are fairly common, and could be increased by judicious fire-protection and cultivation. *Afzelia africana* is more localised, and *Khaya senegalensis* grows mainly above the eighth parallel.

A REPORT on the eruption of Taal volcano (Luzon) of January 30 has been issued by the Rev. M. Saderra Masó, assistant director of the U.S. Weather Bureau in the Philippine Islands. The volcano rises from Volcano Island in Lake Bombon, lies about 39 miles south of Manila, and is 996 feet in height. On the night of January 27–28 the volcano began to emit black smoke from its main crater instead of the usual clouds of white steam. This was accompanied by rumblings and earthquakes. During the next two days the explosions and earthquakes increased in strength and frequency until about 2.20 a.m. on January 30, when a tremendous explosion occurred, which is said to have been heard at a distance of 250 miles from the volcano. A huge black cloud issued from the crater, and there was a heavy fall of boiling mud, which destroyed all the houses and vegetation in Volcano Island and along the western and north-western shores of the lake to a distance of 10 miles from the crater, and caused the loss of more than 1250 lives. Along these shores the mud formed a layer 2 or 3 feet in thickness. The opposite shores escaped with little or no fall of mud, the wind having been from the south-east. The damage was increased by the waves produced in the lake, which reached a height of 10 feet. The rush of air towards the volcano was perceptible for many miles. At Batangos, 17 miles distant, an abrupt fall of 2 mm. in the atmospheric pressure was registered. Volcanic dust was carried so far as Manila. Earthquake shocks, though never of destructive intensity, were extremely frequent, nearly a thousand having been recorded at Manila from January 27 to February 7, when the eruption ended and the ground ceased to tremble.

THE summary of the weather in the several districts of the United Kingdom for the first quarter of the current year, as comprised by the thirteen weeks ended April 1, has just been issued by the Meteorological Office. The mean temperature for the period was nowhere very different from the average, and the record of absolute temperatures was not at all exceptional. The highest temperature in any district during the three months was 63°, which occurred both in the east and south-west of England. The lowest temperature was 11° in the east of Scotland and 13° in the south-west of England. The aggregate rainfall for the period was less than the average in all districts except in the east of England, where the excess for the three months was 0·63 inch. The greatest deficiency was 3·19 inches in the south of Ireland, and in the north of Ireland it was 2·74 inches. The greatest deficiency in any of the English districts was 1·88 inches, in the south-west of England. The largest absolute measurement for the period was 14·42 inches in the north of Scotland, the smallest 3·99 inches in the north-east of England. The number of rainy days was nowhere very different from the normal; the highest number was 58 days in the north of Scotland, the lowest 42 days in the Midland counties. The hours of bright sunshine were in good agreement with the normal; the longest duration was 269 hours in the Channel Islands, the shortest 196 hours in the Midlands. At Greenwich the mean temperature for the three months was in absolute agreement with the average; the rainfall was 0·01 inch less than usual, whilst the bright sunshine was 25 hours deficient. For the six months October to March inclusive, which comprises the whole winter, the mean temperature at Greenwich was 43·0°, which is 0·6° in excess of the average. October and December were decidedly warm months, whilst November was decidedly cold. The lowest shade temperature at Greenwich during the winter is 22°, which occurred both in November and February. Out of 182 days there were 94 days with the temperature above the average, and frost occurred on 37 nights. There were 99 days with rain, yielding a total of 13·31 inches, which is 1·49 inches more than the average; November, December, and March were wet. The total duration of sunshine in the six months was 319 hours, which is 63 hours fewer than the average.

THE meteorological charts of the Atlantic and Pacific Oceans for March and April published by the U.S. Weather Bureau contain useful notices (1) on West India hurricanes, which usually occur between July and October. Particulars are given of some of the more destructive storms, with remarks on the premonitory signs of the approach of tropical hurricanes generally. The tracks of those which occurred in 1900–9 are laid down on charts for separate months. The storms are liable to appear in any part of the region between lat. 7° and 31° N., and east of the ninety-fifth meridian, and to recurve at any point between far to the east of the Bahamas and the west coast of the Gulf of Mexico. (2) Cyclones and anticyclones. The first clue to the rotatory character of storms is attributed to Benjamin Franklin, in 1747. As he was unable to observe an eclipse of the moon at Philadelphia owing to stormy and cloudy weather, while his brother at Boston experienced clear weather, he made inquiries as to the behaviour of the storm in question, and as a result of the investigation he came to important conclusions on the movements of storms in general. Some useful explanations are given by the author of this notice of the conditions at work in weather changes, and of the origin of storms.

THE *Verhandlungen der Deutschen Physikalischen Gesellschaft* for February 28 contains an account of a theoretical and experimental investigation of the best practical method of winding the coil of a needle galvanometer, by Dr. W. Volkmann. Maxwell showed long ago that the wire should increase in diameter as the windings get farther from the centre, and Volkmann finds that the nearest practical approach to this is to make the diameter of the wire used for successive portions of the coil increase in geometrical progression. The loss of efficiency due to this step by step change is proportional to the ratio of the step. The winding should be stopped when the loss due to stopping it is equal to that due to the ratio of the step. By finding experimentally the deflection due to single turns of various diameters, and in different positions, and dividing the deflections by the lengths of the turns, he finds that the best shapes of the parts of the coil are not quite those given by Maxwell, the deviations being greatest for the parts near the needle. With the new winding a coil of only 3·7 cubic centimetres produced the same deflection as a coil of 47 cubic centimetres wound on the old lines. Each coil consisted of four parts, and had a resistance of 5·5 ohms.

The Scientific American for March 18 is devoted to cement and its uses. An interesting article by M. L. Davey gives particulars of methods of saving trees which have partly rotted by means of cement fillings. Once

decay has started in a tree, its progress is rapid. Decay attacks and disintegrates the dormant tissues first, and gradually works outward. Cement in trees fulfils the three-fold purpose of stopping decay, serving as a structural support, and providing a surface over which the bark may heal. Tree surgery may be likened to dentistry; all existing decay must be removed, and means taken to prevent further decay; the cavity must be prepared so that the filling will stay permanently in place, and all foreign substances must be excluded. Chisels and gouges are employed to remove existing decay, which must be followed throughout limbs and trunk so far as it goes. Corrosive sublimate or a similar solution may then be used to destroy any remaining fungi. The walls of the cavity must then be thoroughly waterproofed to protect the wood. Before filling in the cement, the cavity must be well braced, if of considerable size, with steel ribs or truss rods. Skill is required in this matter, so as to allow for the natural swaying of the tree. Water is excluded by cutting a "water-shed" at the edge of the cavity, to which an adhesive waterproofing material is applied. The filling must be under the edge of the bark at every point in order to permit of the bark healing over the filling.

MESSRS. MACMILLAN AND CO., LTD., have published an Index to vols. xi.–xx. (1901–10 inclusive) of *The Economic Journal*, the journal of the Royal Economic Society, which is edited by Prof. F. Y. Edgeworth, assisted by Mr. H. B. Lees Smith, M.P. The index has been prepared by Miss Ethel R. Faraday.

IN our issue of December 26, 1907 (vol. lxxvii., p. 172), attention was directed to Mr. Nasarvanji Jivanji Readymoney's "Science of Nature-History." The author has sent a copy of a reissue of his work—in which he has modified the title and added an introductory page—and also a pamphlet entitled "A Programme of Education," in which he commends the heuristic method of teaching.

MESSRS. BAILLIÈRE, TINDALL AND COX announce that the new edition of Green's "Pathology" will be ready for publication by the end of the month. The work has again been revised by Dr. Bosanquet, much new material added, and rearrangement of subjects made. Its format has also been modified for inclusion in the "University Series of Manuals," which contains such volumes as Stewart's "Physiology" and Dawson Turner's "Medical Electricity."

OUR ASTRONOMICAL COLUMN.

HALLEY'S AND FAYE'S COMETS.—Dr. Max Wolf records, in No. 4486 of the *Astronomische Nachrichten*, recent observations of both Halley's (1909*c*) and Faye's (1910*e*) comets at the Königstuhl Observatory. On March 19 the former was still an easy object for the large reflector, its magnitude being about 14·0; no nucleus was visible, the comet appearing as a round nebulous disc of about ½ minute diameter.

Faye's comet on the same evening was fainter than Halley's, its magnitude as a whole being about 15·0. A sixteenth-magnitude nucleus of about 10″ diameter was situated nearer to the southern edge of the circular nebulous disc; the comet is still an easy object to photograph with the large reflector; an observation on March 23 gave the magnitude as 14·5.

COMET 1910*a*.—An excellent photograph of comet 1910*a*, taken on January 28, 1910, with a Voigtländer "Dynar" objective by Dr. Karl Bohlin at the Stockholm Observatory, is reproduced as a plate in No. 2, vol. xxxiii., of *The Astrophysical Journal*. The principal tail extends to a length of 18°, and is bifurcated at its extremity; in addition, there issues from the slender head a secondary tail 2° long.

Prof. Riccò gives an account of the Catania observations, photographic and spectroscopic, of this comet in No. 2, vol. xi., of the *Memorie di Astrofisica ed Astronomia*. He reproduces several drawings and photographs showing the magnificent main tail and the small secondary one. In regard to the latter, he suggests, with great reserve, that its formation may have been an effect of the proximity of the comet to Venus, the distance separating them on January 27, 1910, being about 133 million kilometres. The Catania drawings for January 22 and 23 show the nucleus to be on the outer, convex edge of the **U**-shaped tail.

A PROPOSED METHOD OF DETERMINING SPECTRAL TYPES QUANTITATIVELY.—On January 24, 1907, we noted in these columns (NATURE, No. 1043, vol. lxxv., p. 304) the results obtained by Dr. Sebastian Albrecht, then of the Lick Observatory, from a study of the varying intensities of certain lines of compound origins found whilst measuring spectrograms for the determination of radial velocities. Briefly, the author found that, in consequence of the variation in intensity of the components from one spectral type to another, there was a progressive variation of the apparent wave-lengths of the compound lines. Further, it was suggested that, by inverting the problem, it might be possible to determine the finer differences in spectral type by careful measurements of the wave-lengths.

In the current number of *The Astrophysical Journal* (vol. xxxiii., No. 2, March, p. 130) Dr. Albrecht, now at the Córdoba Observatory, gives the preliminary results of such an investigation. One of the chief difficulties is to state definitely and numerically the intervals between the several spectral types F, G, K, and M of the Draper classification, but this is overriden by arbitrarily taking them as equal, and making M*a* and M*b* one-tenth of an interval on either side of M. Curves were then constructed with type-intervals as abscissæ and variation of wave-lengths as ordinates, so that accurate measurements of the wave-lengths in the spectrum of the star under discussion would show at once the exact position of that star in the classification; generally speaking, these curves show that the changes in wave-length are regularly progressive from type F to type M.

To illustrate the application of the method, eight stars were chosen, and the selected variable wave-lengths were measured in each, the results being recorded as weighted departures, in tenths of an interval, from the nearest main type. A considerable variation is shown among the individual results from each of the selected lines, although the probable error of the final result from all the lines is, in each case, not great; also, the accordance with the Draper classification is fairly good. Dr. Albrecht considers that the scheme is workable, and that when further developed it will afford a ready method of determining quantitatively the spectral type of the stars observed. He also suggests that in order to avoid special measurement a number of his selected compound lines should be included in all future measurements of spectrograms for the determination of radial velocity; it would appear, however, that for radial-velocity work it is better to use the purest lines possible.

MERIDIAN OBSERVATIONS AT THE ROYAL OBSERVATORY, BELGIUM.—The second part of vol. xii., of the *Annales de L'Observatoire Royal de Belgique* contains the detailed results of more than 2000 observations made with the Repsold meridian circle during 1909–10 (June), by MM. Philippot, Delporte, and Jamar. The principal object was to complete the observations of the *étoiles de repère*, but observations of the sun, the moon, and the planets, and of comparison stars for comets and for use in determining the movements of certain double stars in Burnham's general catalogue, were also made. Since August, 1909, a Repsold registering micrometer has been employed, and during the same year important modifications were made in the meridian room; among other alterations, the foundations of the pillars were encased with insulating material to prevent variations introduced by changes of temperature.

The volume also contains an interesting account of a comparative study of the errors of two chronographs, one by Gautier, the other by Dent.

POPULARISING ASTRONOMY.—From the *Rochdale Times* we see that the Rev. W. G. Pritchard is making an excellent innovation, for the popularisation of astronomy, in connection with the Education Guild of the town. The Guild meets frequently for the discussion of art, science, and literary topics, and the programme for Tuesday night was an open-air talk on the stars. The weather being favourable, the members were to gather in the vicarage field and there discuss the various celestial objects, under the leadership of Mr. Pritchard. We would commend this programme for general adoption among similar associations.

RELATIONS OF PHENOLOGICAL AND CLIMATIC VARIATION.[1]

THE monograph referred to below deals with the flowering date of thirty-nine plants for the years 1896–1909. Unfortunately, only ten, or 25 per cent., were noted for every year, and six were observed in seven to nine only of the fourteen years.

The observations were of herbaceous plants, shrubs, and trees that had grown at least two years in the meteorological enclosure of the Royal Observatory grounds at Uccle, two miles south of Brussels, on level ground, 340 feet above sea-level, all on clay soil. Observations were in each case made on the same individual plant, such as were well exposed being selected. In five chief essentials they were therefore ideal, identity of well-placed specimens, of soil, of location, of elevation, and of the observer, M. Jean Vincent, always on the spot. The series opens with *Corylus avellana*, February 25, and closes with *Aster horizontalis* (1900–7 only), September 15. The months represented are February 1, March 2, April 10, May 14, June 7, July 4, and September 9.

After an introductory survey, in which reference is made to the far greater number of factors now known to influence the flowering date than was once supposed, M. Vanderlinden notes the increasing importance assigned to the completion by each species of its "period of repose," on which, largely, the mean date of flowering depends. The research dealt largely with the influence, in association with this, of meteorological influences, as shown both by observation and experiment.

The test for "flowering," as customary also in this country, was the exposure of the stamens. It is not, however, stated whether for the hazel the pistils were observed instead, these being far less erratic than the staminiferous flowers.

Flowering is much more definite, and therefore better suited for such observations, than other phases, such as leafage, fruiting, and defoliation. The first tables give the flowering date for each year, with the mean for the years observed. It would surely have been well to intercalate dates for the missing years. To do this satisfactorily is indeed rather complicated, and such values are not equal to actual observed dates. But it would be safe to count the error as at most a quarter of that where such precaution is omitted. Thus the mean date given for *Ribes nigrum*, April 10, is that from 1903 on. The corresponding years for *Corylus avellana* give February 19, but that tabulated (on thirteen years of the fourteen) is February 25. For the other years, 1896 and 1898–1902, the average is March 3. The divergence at the later dates, we shall see, would be much less, but the argument would be equally affected. Thus *Ribes rubrum* is given April 10 (1903–9), *R. alpinum* April 14 (1898–1909). But the latter, on the mean of 1903–9, should be April 10·9. These discrepancies are less important for the investigations in hand than had these dealt more specially with relative dates of flowering, but they can hardly be neglected.

In looking at the dates, it is noticeable how much less range there is from the mean in the case of the earlier flowers than in British observations of the few for which there are common records. Thus for the hazel, for Uccle and Purley (Surrey), respectively, the range since 1906 is from February 17 to March 10, and February 1 to March 20; blackthorn, April 11 to May 1, and March 17 to April 27; but for dog rose, May 26 to June 4, and June 1 to 10.

The next subject dealt with is the relation between departures from the mean flowering date and the corresponding variations in the meteorological factors. Comparative curves are given for five such, namely, maximum and minimum temperature, radiation as shown by Bellani's alcohol radiometer, humidity, and rainfall. The last two were found to be relatively negligible, and, in the earlier months, the same is true of the third. Florescence depends, then, mainly on temperature, as the effective food stores are already present. Later on, foliage must precede flowering to supply chlorophyll, which necessitates light. But from June on heat is again the predominating factor, since the interval between foliage and flower is so long. These curves are given year by year. It is by careful examination of these, and confirmation of results, where possible, by experiment, that M. Vanderlinden reaches his conclusions. Naturally, there is always a certain amount of lag, but this is less with the herbaceous plants. The most effective combination is high temperature and radiation, with feeble humidity lasting for several days before the normal flowering date.

The chief experiments consisted in subjecting the plants to warm baths, to moist warm air, to various light conditions, to special warmth treatment over a definite time, followed by ordinary conditions. Some twenty conclusions are drawn, among which, besides those already mentioned, are the following:—

When blooming has been retarded it follows upon less stimulus.

Phenology is practically evidential for temperature and sunshine alone, and then only for approximate values.

Effects may remain latent (and so cumulative) over short periods.

Heredity determines the normal date.

Autumn and early winter have no influence [in Belgium].

Groups flowering concurrently vary concurrently. The evidence given for this is perhaps too limited for the conclusion.

It is certainly so in another case. Anyone who has dealt much with sun-spots would hardly venture on any conclusion from data confined to fourteen years. Hence the statement that no relation shows itself should rather have been that, as the observations have not yet been carried on for fifty or one hundred years, it is too early to investigate the matter. The sun-spot table was hardly the best way to utilise the space. Is not this true also of the fourteen tables of daily temperatures and radiation? One would have been content with a summary to compare with the valuable plates, based upon the figures, if instead we could have had further investigations worked out from the observations. It would have been especially interesting to have had relative results month by month, as, for instance, the relation between annual variation and the cumulative values above some minimum, below which the given plant showed no response to the effective factors of heat and light.

But, in asking for more, it must be understood that this is because of the excellent value of that which is given.

J. EDMUND CLARK.

[1] "Étude sur les phénomènes Périodiques de la Végétation dans leurs Rapports avec la Variations climatiques." By Dr. E. Vanderlinden. Extrait du Recueil de l'Institut botanique Léo Errera, tome viii. Pp. 67, with Tables and 16 plates. (Bruxelles: Hayez, Imprimeur des Académies Royales 1910.)

NON-EUCLIDEAN GEOMETRY.

IT is now well known by all mathematicians that Euclid's theory of parallels is not indispensable for the construction of a self-consistent geometry, but that, on the contrary, there are three coordinate systems, of which Euclid's is one, equally entitled to consideration, and equally general. So far as we can see at present, the strict proof of this statement must be analytical; at any rate, when we suppose that the elements—lines, points, planes, &c.—are, in the space considered, exactly analogous to the corresponding elements in Euclidean space. However, it fortunately happens that we can construct a non-Euclidean geometry in ordinary space by suitably changing the definitions of its elements, and this is, at any rate, of considerable help in convincing a student of the possibility of the non-Euclidean systems. Prof. H. S. Carslaw has recently explained one such method

(Proc. Ed. Math. Soc., 1909–10) which deserves attention as being a very simple image of hyperbolic geometry in Euclidean space.

We start by taking a fixed sphere σ, and define a plane α as a sphere which cuts σ orthogonally, a line as a circle which cuts σ orthogonally, a point as a point-pair inverse with respect to σ. All the ordinary projective axioms are satisfied; the angle between two planes is defined to be the angle, in the ordinary sense, at which the representative spheres intersect. If two planes touch, their point of contact must lie on σ; in this case they are said to be parallel. It is easily proved that through any point (not on σ) two planes can be drawn parallel to a given plane α; triangles exist with each angle zero, and so on. Moreover, it is possible to give a definition of length (as the logarithm of a cross-ratio) which enables us to say that if A, B, C are three collinear points, AB+BC=AC.

If σ shrinks up to a point, the geometry becomes Euclidean, though the elements are not the usual ones. We may, however, abstract from the point S, which is the limiting form of σ, and define a point A in the ordinary sense. Then line and plane elements are represented by circles and spheres through S.

It must be remembered that this theory assumes metrical and other properties of ordinary space, and does not pretend to put hyperbolic geometry on an independent footing. To do this requires a more detailed discussion, and the assumption of a hyperbolic space. In a somewhat analogous way we may consider the question of dimensions in space. We have a real four-dimensional geometry in ordinary space if we take as our primary element a line or a sphere, and so we may construct geometries of any dimension we like. But it is another thing to assume a four-dimensional space where (x, y, z, t) can be taken as, say, rectangular Cartesian coordinates of a point strictly analogous to the corresponding point-element in three-dimensional Euclidean space.

G. B. M.

MICROBIOLOGY IN NEW SOUTH WALES.[1]

WHEN we consider that the report referred to below deals with more than thirty-three thousand examinations, embracing all kinds of subjects, the difficulty of giving any adequate description of the contents will be appreciated. As this report is an introductory one, the plan has been adopted of writing an introduction to each section suitable for non-scientific readers, who may thus be able to follow intelligently the matter discussed; for beyond conducting routine work, the Bureau has set before itself the praiseworthy task of becoming a centre of useful knowledge. But it is further recognised that in the direction of research the Bureau will find its largest sphere of usefulness. This is no doubt true, and it is for the official mind to recognise that the man engaged in routine examinations cannot even succeed at this unless he too is sometimes allowed to engage in research.

To turn to the actual work, we find that tuberculosis ranks first in the numbers of specimens (487) supplied, while typhoid fever ranks second with 214. Perhaps an unnecessarily pessimistic view is taken as to the prospect of being able to control either the "carriers" or the fly in the case of this disease. At present our study of the house-fly is only commencing, and we think it probable that in urban areas it will prove to be very amenable to control. The formula "no dirt, no flies," would express the position we should take up.

It is recorded under the diphtheria examinations that cultures very often do not show diphtheria bacilli in twenty-four, but may do so in forty-eight, hours. But surely one may add the progress of knowledge is slow, for this fact was within the writer's experience twenty years ago when examining cultures in a large hospital. With regard to the protozoa, it is extremely interesting to note that malaria, though prevalent in the northern parts of Australia, occurs only as imported cases in New South Wales, though Anophelines abound there. The unravelling of that somewhat puzzling condition, *paludismus sine malaria*, still demands attention, and here we have another example of it. A large number of new species of bird plasmodia are recorded, though whether these "species" could be distinguished if it were not known from what birds the blood came is, we think, very doubtful. Several new hæmogregarines are also recorded from snakes and tortoises. Besides these scientifically interesting parasites, there are several diseases of unknown causation in cattle of economic importance, *e.g.* endemic hæmaturia in cattle, jaundice in lambs, and black disease in sheep, but piroplasmosis is not recorded. As regards entozoa, those of New South Wales make quite a respectable list, but perhaps by dint of including rarities. Hydatids appear to be the commonest entozoal parasite in Australia, occurring in man, sheep, cattle, and pigs, but rarely in horses.

A very interesting parasite affecting cattle is a filaria-like worm coiled up in subcutaneous tumours, known as "worm-nests." These have excited considerable interest among health officers in London and Liverpool lately, owing to their occurrence in frozen carcases from Australia. They are about the size of a split walnut, and occur, for the most part, over the brisket. It does not appear to be possible that they can be injurious to man. It should be mentioned, however, that it has been stated by one observer that they are associated with tuberculosis, but this is against the weight of evidence. The sanitarian's scruples may, indeed, be allayed by the evidence we have that, although such carcases are used as food in New South Wales, no injurious results have ever been known to arise therefrom.

An examination of telephone mouth-pieces (50) failed to detect tubercle or diphtheria bacilli. The examination of milk preservatives leads to the conclusion that to delay manifest change for even twenty-four hours involves the use of medicinal quantities, the long-continued ingestion of which may be injurious. In the milk question, the means of salvation is, we think, clear—prevention is better than cure. Finally, the rabbit problem must be referred to, and the interesting proposal to destroy rabbits by destruction of females and liberation of males is now being tested.

The director and his colleagues deserve warm commendation for the results of their first year of evidently very laborious work which this report chronicles, and which must soon justify itself, not only scientifically, but also economically.

[1] Report of the Government Bureau of Microbiology for the Year 1909. (Legislative Assembly, New South Wales.)

SCIENCE AND EDUCATION IN THE CIVIL SERVICE ESTIMATES.

THE Estimates for Civil Services for the year ending March 31, 1912, together with a memorandum by the Financial Secretary to the Treasury, have been issued as a Parliamentary Paper. The following particulars with reference to the money under this vote to be devoted to science and higher education are taken from this paper.

Under the sum required for Public Works and Buildings, the Estimate for the Royal Parks and Pleasure Gardens shows an increase of 5725*l.* on the year, in which provision is made for completing the new laboratory in the Edinburgh Royal Botanic Garden at a further cost of 3790*l.* Under Surveys of the United Kingdom (which have shown an annual decrease of cost since 1902–3, when the expenditure amounted to 237,130*l.*), there is a further decrease of 5452*l.* for the year, the estimated net charge amounting to 187,344*l.*

Under the heading Salaries and Expenses of Civil Departments, the Estimate for the Board of Agriculture and Fisheries shows a net increase of 9204*l.*; 43,589*l.* is included in respect of the expenses of a scheme for the Improvement of Light Horse Breeding. The expenditure for this purpose, less a sum of 5000*l.*, will be recouped by a grant from the Development Fund, and the grant of 5100*l.* hitherto paid to the Royal Commission on Horse Breeding ceases after the year 1910–11. 5000*l.* of the increase is, therefore, in effect a transfer from this latter Vote. 2250*l.* is included as grants to local authorities in aid of the provision of local inspectors for the purpose of the Destructive Insects and Pests Acts, 1877 and 1907, and 1050*l.* additional is required for the Collection of Agriculture and Fishery Statistics.

The Estimate for the Government Chemist appears for the first time as a separate Vote. In previous years the salary of the principal chemist was borne on the Treasury

Vote, and the other salaries and expenses of the Government Laboratory were charged to the Customs and Excise Vote.

The Estimate for the Department of Agriculture and Technical Instruction, Ireland, exhibits a net increase of 10,253*l.* Of this amount, 3275*l.* is due to an increased grant-in-aid to the Royal College of Science, and 5500*l.* to an increase in the annual grants to schools and classes of science and art and technical instruction. The sums of 17,000*l.* granted from the Development Fund for the purchase of areas of afforestation, &c., and 10,000*l.* for the improvement of horse breeding, are appropriated in aid of the Vote for this Department to cover the expenses incurred for those purposes.

The total provision for education, science, and art is 19,141,264*l.*, being a net increase of 468,900*l.* on the amount voted in 1910. The Estimate for the Board of Education shows a net increase of 310,840*l.*, of which 229,355*l.* arises under grants in respect of public elementary schools, 13,000*l.* under grants for training of teachers, and 64,500*l.* under grants for technical institutions, schools of art, evening schools, &c.

The Estimate for Universities and Colleges, Great Britain, and Intermediate Education, Wales, exceeds that for 1910–11 by 64,700*l.*, after taking into account a Supplementary Grant of 21,000*l.* in 1910. Of this increase, 10,500*l.* occurs under the subhead for Scottish Universities, and 50,000*l.* under Colleges, Great Britain.

The Estimate for Public Education, Scotland, shows an increase of 82,869*l.* The estimated number of scholars in day schools has risen from 737,576 to 764,397 for the year, and the annual grants for day scholars are increased by 64,647*l.* The provision for grants for continuation classes and secondary schools shows an increase of 16,800*l.*

The increase of 18,176*l.* in the Estimates for Universities and Colleges, Ireland, is due to additional grants for land, buildings, and equipment for the Irish universities.

Among the amounts required for different purposes, the following are interesting:—art and science buildings, Great Britain, 99,900*l.*; surveys of the United Kingdom, 187,344*l.*; Government chemist, 19,088*l.*; Board of Education, 14,375,442*l.*; scientific investigation, 61,603*l.*; universities and colleges, Great Britain, and intermediate education, Wales, 303,800*l.*; public education in Scotland, 2,336,594*l.*; public education in Ireland, 1,653,324*l.*; and universities and colleges, Ireland, 186,256*l.*

A table included in the paper provides interesting information as to the growth of expenditure or otherwise under different headings. Take, for instance, the cases of the Board of Education, and the universities and colleges in Great Britain and intermediate education in Wales, the grants have steadily increased since 1902–3. Under the heading scientific investigations there is no such decided increase to record, as the following table shows:—

	£		£
1902–3	62,932	1906–7	56,868
1903–4	87,300	1907–8	53,823
1904–5	54,484	1908–9	55,349
1905–6	53,343	1909–10	83,338

Grants in Session 1910 for 1910–11, £74,228
Estimates 1911–1912, £61,603.

THE IMPERIAL EDUCATION CONFERENCE.

THE following representatives from the self-governing dominions are expected at the forthcoming Imperial Education Conference, which will be held on April 25–28 inclusive:—*The Dominion of Canada:* The Hon. R. A. Pyne, Minister of Education, Ontario, or Dr. A. H. W. Colquhoun, Deputy Minister of Education, Ontario; Dr. A. H. McKay, Superintendent of Education, Nova Scotia, with whom will be associated the Rev. Dr. MacGill, professor of philosophy, University of Dalhousie; the Hon. George R. Coldwell, Minister of Education, Manitoba; the Hon. Henry E. Young, Minister of Education, British Columbia; the Hon. W. F. A. Turgeon, Attorney-General, Saskatchewan. *The Commonwealth of Australia:* Mr. P. Board, Under Secretary in the Department of Public Instruction and Director of Education, New South Wales; Mr. C. R. P. Andrews, Inspector-General of Schools, Western Australia. *The Union of South Africa:* Dr. Thomas Muir, C.M.G., F.R.S., Superintendent-General, Cape of Good Hope; Dr. W. J. Viljoen, Director of Education, Orange Free State.

The Dominion of New Zealand will be represented by the Hon. Sir William Hall-Jones, K.C.M.G., High Commissioner in London for the Dominion, and the States of South Australia and Tasmania will be represented, respectively, by the Hon. A. A. Kirkpatrick, Agent-General in London for the State of South Australia, and the Hon. John McCall, Agent-General in London for the State of Tasmania.

The following local Governments in India have arranged to be represented as follows:—the Government of Madras by Dr. A. G. Bourne, F.R.S., Director of Public Instruction in the Presidency of Madras; the Government of Bombay by Mr. A. L. Covernton, principal and professor of English literature, Elphinstone College, Bombay; the Government of Bengal by Mr. B. Heaton, principal of the Sibpur Civil Engineering College, Bengal; the Government of the Central Provinces by Mr. S. C. Hill, late Director of Public Instruction in the Central Provinces, and Mr. C. E. W. Jones, principal of the Morris College, Nagpur; the Government of Burma by Mr. W. G. Wedderspoon, Inspector of Normal Schools, Burma.

The representation of the Crown Colonies will be as follows:—Falkland Islands, Mr. T. A. V. Best, Colonial Secretary; Gold Coast Colony, Mr. J. W. Church, Director of Education; Jamaica, Mr. G. H. Deerr, Inspector of Schools; Leeward Islands, Mr. H. E. W. Grant, Colonial Secretary; Malta, the Hon. Prof. Enrico Magro, Director of Public Instruction and Rector of the University of Malta; Straits Settlements, Mr. H. T. Clark, principal of the Malay College, Malacca; Trinidad, Mr. George Goodwille, formerly a Member of the Legislative Council.

The conference will be attended by representatives of the India and Colonial Offices and of all the Home Education Departments—English, Scotch, and Irish. The States of Guernsey, Jersey, and the Isle of Man have been asked to nominate representatives.

The morning sessions of the conference will be confined to official representatives, and devoted to the consideration by them of such matters as the various overseas Governments have suggested for discussion or any delegate may wish to bring before the conference. The arrangements for the afternoon sessions will be announced later. A preliminary meeting of official representatives will be held on Monday, April 24, for the purpose of settling finally the programme for the morning sessions of the conference.

AGRICULTURAL BULLETINS.

THE Agricultural Experiment Station of the University of Wisconsin is one of the most active centres of scientific work in agriculture in the United States. Problems are attacked from two distinct points of view: the economic, in which the object is to show how crops may be produced a little more cheaply than at present, and the scientific, the problem being investigated for the sake of the general principles it may bring out. Two sets of bulletins are therefore issued, the popular bulletin, intended for farmers, dealing mainly with local problems, and always from the local point of view, and the research bulletins. The popular bulletins are fully equal to any others in the United States, and much ahead of anything we publish here for farmers; in the series before us the subjects dealt with include land drainage, curing of seed corn, control of various weeds, draft-horse judging, a discussion of the methods of paying for milk at cheese factories, and so on. The research bulletins are the scientific papers of the staff; as usual in the United States, each paper is published separately, and there is no common journal in which they all appear.

Three of the papers referred to above deal with cheese-making, perhaps the least understood of all agricultural processes. Messrs. Sammis, Suzuki, and Laabs discuss the factors regulating the rate at which whey separates from curd in the cheese vat. High acidity, high temperature, and pressure applied to the curd all facilitate rapid separation, but, on the other hand, variations in the proportions of rennet and the time of action of the rennet have no effect. In another paper Messrs. Suzuki, Hastings, and

Hart deal with the production of volatile fatty acids and esters in the making of cheddar cheese. The acids found were acetic, propionic, butyric, and caproic, but not valerianic acid; none of these seemed to be formed from lactose, although the ethyl alcohol probably was obtained from this compound. Mr. McCollum describes how he succeeded in keeping rats alive for a considerable time on a ration containing inorganic phosphorus compounds and no purine bases; it was necessary for success that the ration should be varied as widely as possible in order to make it palatable. Young rats withstood the unpalatability for a long time, and, indeed, were healthy to the end of the experiment. He concludes that animals can synthesise their complex phosphorus compounds, including nuclein, from inorganic compounds, and, further, that they can synthesise the purine bases from some complex present in the protein molecule. In the last paper of the series Messrs. Hart and Tottingham show the presence of phytin in seeds of maize, oats, and barley. This substance is a complex combination of potassium, magnesium, and calcium with phytic acid, $C_2H_8P_2O_9$, which in turn is broken up on hydrolysis to form inosite and phosphoric acid.

TREE PLANTING IN TOWNS.[1]

THE tree, standing singly, collected in masses forming woods, or grown as a beautiful avenue, is a fascinating object of study once the attention has been arrested upon it. Difficult it is to realise that an object of such size, majesty, and strength as a fine old tree represents has sprung from a tiny seed—a seed which if placed in the palm of the hand may, to the non-expert, prove indistinguishable from the seed of a small herb or grass of the field. Yet in the one case the tiny seed contains within it the germ which will produce a green monument of 100 to 200 feet or more in height, a living monument which will withstand the storms and changes of centuries, and may witness the downfall and uprise of dynasties and nations. Its seasonal garb does not pass through the kaleidoscopic changes of fashion which man in these later days is heir to.

The tree has but the four changes of garment which appear regularly with the changing seasons throughout its life, but this raiment has never failed in its attraction for man. Beautiful as are the tender greens of spring, the deeper, more mature greens of summer, and the brilliant tints of autumn, he who studies trees finds something equally beautiful, even if not more beautiful, in the stern grandeur, with its latent promise of strength, exhibited in winter.

The tree has had a greater influence in the training and civilisation of mankind than is perhaps generally realised, certainly more than is realised by the man of the city and town. Long centuries ago the greater portion of the land of the globe was covered by vast primæval forests in which man lived a primitive existence, and against which he waged an unequal war. But he was dependent upon the forest for the greater part of his means of subsistence, whilst his house, furniture, cooking utensils, such as they were, and implements, offensive, defensive, and cultural, were all fashioned from the materials of the forest.

As man increased in number and became more civilised, he cleared larger and larger areas of the tree growth, and now took to living outside, but still in the neighbourhood of, the forest. Still he depended upon the forest for most of the necessaries of life, from the materials for constructing his house down to a chief portion of his daily food.

It was only with the great increase in number of mankind and with his concentration in certain localities, usually the fertile lowlands from which the forests had been cleared, that these sections of the human race began to depend less and less on the forest as one of the chief staffs of life.

But we see that the instinct of man in the earlier days in the history of the world was to look to the forest as nature's great storehouse from which he could obtain the necessities of his daily life. It is so with the nomadic races of the world at the present day. I wish to make this point, as it explains, I think, the inherent love of trees which lies in the nature of each one of us, though in the city-bred man it may to some extent remain dormant.

It explains another point, on which I propose to briefly dwell, the instinct of man, if left to himself in a bare, treeless region to plant trees or tree growth, or bushes even, to brighten the monotony of his otherwise dreary surroundings. For those of us who have experienced nature in its awesome loneliness in the absence of tree growth of any kind, know full well how appallingly depressing it can become.

In such localities man, if left to himself, will, I say, start planting trees, and will take extraordinary trouble to make them grow. Some years ago I was deputed by the Government of India to visit Quetta, the beautiful capital of Baluchistan—that rugged province situated in the far north-west of India on the frontier of Afghanistan and Persia. Quetta occupies the central Highland of Baluchistan, and is a point of considerable military strategic importance. It is situated at about 5500 feet, and is surrounded by great barren peaks ranging up to 11,700 feet. The railway climbs to it through a dreary rugged waste of rock and sand, with here and there little villages embosomed in trees and surrounded with small areas of crops. It is a wild country, and the history of Quetta fully illustrates my point that man in such a country will plant trees for dear life.

The main station of Quetta was formed after Lord Roberts's march to Kandahar. At the time the first houses were built, save for the fact that the villages around contained some poplars and willows and fruit trees, the site consisted of a barren plain. The planting was first started in 1878 by Mr. Bruce. After the evacuation of Kandahar, the work was taken up mainly by Mr. (now Sir Hugh) Barnes, General Sir Stanley Edwardes, who was in command of the troops, Colonel Gainsford, and Mr. Watson, the forest officer. A tree committee was formed, and large nurseries established. The trees were obtained from Kandahar, a beginning being made in the winter of 1881–2, when some 60,000 cuttings or slips of the chenar or plane tree, poplar and willows, were brought on camels from Kandahar and planted out along the roadsides and in the gardens. The planes were put on the main road, the Lytton Road. They form a magnificent avenue, now thirty years old, which gives a most grateful shade in summer, considerably lowering the temperature. The growth of the trees was wonderfully rapid, irrigation being then, as now, employed to water them; for all the water in the country is brought in channels from the sources of the springs, its value being fully understood by the inhabitants, who show great ingenuity in constructing these water channels. Other roads were lined with poplars or willows, and if a mistake was made it was in planting the trees too close, and in planting the avenues on any one road of one species of tree only; and this mistake had to be paid for later on somewhat dearly, to which allusion may be made. The trees were attacked by a cerambyx beetle pest (*Æolesthes sarta*) the grubs of which fed in the green inner bark—the growing layer—of the trees, and resulted in numbers of the poplars and willows having to be cut out and burnt.

Not only in Quetta, but also in all the cantonments throughout Baluchistan, the planting of trees forms one of the chief recreations of the British community, so great is the distaste of mankind, accustomed and used to tree and plant growth, to exist without it. The whole of the work is carried out by the political and military officers stationed in that portion of the country, few if any of whom had, before reaching the country, any planting knowledge, and many of whom had confessedly previously taken but little interest in the growth of trees. Amongst the most enthusiastic of the planting community at the time of my visit was General Sir Henry Smith-Dorrien, now commanding at Aldershot, but then commanding the Quetta division, and he attacked and wiped out the "borer," as they called the beetle pest, in his cantonments with as much keenness as he planted trees.

I have alluded to the fact that the major portion of the land surface of the globe was formerly clothed with vast primæval forests.

In the opening phases of his connection with the forest

[1] Paper read at the Town Planning Exhibition in the Royal Academy Buildings, Edinburgh, March 23, by E. P. Stebbing, Lecturer in Forestry, University of Edinburgh.

man waged a puny and ineffective war against the relentless growth of the forest, and had as much as he could do to keep a small clearing round his abode, and in many cases this was not attempted. Regions in the tropical world exist at the present day where this unequal and never-ending strife between man and the luxuriant vegetation of the forest still goes on, usually in favour of the forest. With increase of numbers, permanent clearings came into being, but the whole of the materials for house-building, &c., came from the forest. At the present day the aborigines of Central India and the Assam and North Burma Hills, as is the case with aborigines in other parts of the world, construct their habitations of wood, grass, and leaves; their household crockery and glass consists of gourds, with lengths of bamboo for the wineglasses, whilst a considerable portion of their food consists of edible fruits and roots and leaves and shoots of forest trees, and when they can procure it, meat from the wild animals of the same forest.

But man, with increased numbers and civilisation, began a ruthless war against the forest, and is still carrying it on in America, Canada, and elsewhere, with the result which now faces us. In Great Britain, once covered with forests, we have no forests at all and few woods of any size, and are at the present moment entirely dependent on our timber, &c., supplies being brought to us from outside. And the sources of this supply are diminishing, and are also being yearly indented on to a greater extent by other countries.

But long before the awakening as to the importance of forests commenced in Europe—a matter of a century or two only—man, the man in the rapidly growing cities and towns, had realised the importance of the tree and the place the tree held in his existence. His primitive instincts, laid to rest whilst engaged in ruthlessly exterminating his friend, were aroused into an active repentance when he no longer had that friend at his door and could no longer watch it garb itself in its brilliant seasonal changes of raiment, and no longer had its protection for himself and his animals against cold or fierce winds, a hot sun, &c. He then commenced, after the fashion of man, energetically, but more or less spasmodically, to endeavour to repair the effect of his own destructiveness. To his surprise, however, he found it was by no means so easy to replace the trees on spots from which he had ruthlessly cut them. Nature's balance had been unduly interfered with; the rich store of good soil built up through the ages in her own storehouses of the past had been wastefully dissipated, and whereas she herself never asked the trees to grow on bed-rock, man did.

Also, as time went on, the atmosphere, especially in the larger cities and commercial centres, became polluted and vitiated with smoke and acids, and man, having no time or wish to study the methods by which nature reclothes the soil when left to herself after he had passed by, gave up his attempts to maintain trees near or within the areas, rapidly increasing in density of population, in which he worked and lived.

We thus arrive at another stage in the history of man and the tree. The city increased in size; the population doubled, trebled, and quadrupled itself; the single-room tenement, as we were shown by Lord Pentland the other day, made its appearance and came to stay; the streets became narrower, the houses higher, and the tree itself disappeared. If we look at the large densely populated capitals of Europe and the great commercial centres of the present day, we find in both that in the parts occupied by the poor classes and workers the significance of the tree as the close neighbour and companion of man throughout a considerable portion of his existence on the globe has been forgotten or lost to view. But the instinct is there, deep implanted in the heart of each one. Even to the born and bred city child, the descendant of several generations of town-bred men, the craving for a sight of a green field or of a wood comes dimly at times. Probably most of us who are acquainted with great cities have come across instances of such. It was my fortune once to see a little youngster from the slums of London taken into a Kentish hop-field. He came from one of the worst parts of the great city, and in all his little life had only seen a grimy plane tree and a dark, sooty green grass plot. In the train, so soon as the open country had been reached, he remained speechless. Once in the hop-gardens he recovered his voice, and went wild with excitement and delight. It was very easy to see man's instinctive love for wild nature and nature's growth there. Equally apparent is it in most of us born and bred in civilised countries when we come face to face for the first time with a tropical forest. Instincts and thoughts to which we fail to give expression surge up within us as we feel that once again we have come into contact with the original homes of our ancestors; and the feelings, mind you, which are aroused by such a contact, which were aroused in that little London lad in the hop-garden, are the very ones which it is to the interest of mankind to keep alive and stimulate.

Mankind does not seem to improve with his growing habit of congregating in dense masses in cities and towns. He appears, somehow, to lose something of that freshness and breeziness which we associate with the mountain top and find in the dweller on the mountain top. In our more spacious, if less civilised and cultivated, days, we lived in closer touch with nature, and there are those who say that in many ways we were better men for the contact. But the closer life in cities is doing something which, as I think, is even worse for human nature than this. We are losing some of the finer instincts, and certainly our finer senses of sight and hearing, and even of smell. I do not speak from any medical knowledge of the subject, but simply from personal observations made during a number of years' contact with the folk of the jungles and mountainous regions of India. They can give us points and a beating in all of the last three; and yet there is no reason to suppose that our ancestors—the ancient Britons, who dressed in blue paint—were not possessed of these finer senses and were not the equal, in these respects, of the present-day aborigine.

Of course, I do not wish to be understood as saying that the town- and city-bred man can hope to remain the equal of the countryman in his knowledge of nature or in those senses which demand to be constantly used to be kept in high order. But my point is that a good deal more might and should be done to help the dweller in the densely populated portions of the great cities and commercial centres to keep to some extent in touch with nature. He should be able to see and live with trees, and to see daily, not only on holidays or at the expense of a long walk, which he will not take, trees and areas of green grass and flowers. We who live in the open air and habitually enjoy such sights, and those who spend several weeks or months in the year annually in the country, find it difficult to picture the mind of a child who has never seen a field of corn and red poppies rippling under the soft summer wind, or the waving tops of a green forest, or heard the soughing of the breeze in a pine wood; and yet there are probably hundreds and thousands such in these islands.

Now it should be quite possible for the rulers of every large city and town to see that open spaces are provided for the recreation of the inhabitants. Much has and is being done in this respect, and this exhibition is a witness to all it is hoped to do in the future. But I am not concerned here with the provision of the open spaces, but with tree planting and the beautifying, not only of the open spaces, a comparatively easy matter, but of the streets and their neighbourhood. When we talk of trees in streets, the usual idea is, I think, an avenue. Those who have seen the beautiful lime avenue at Trinity College, Oxford, know what a beautiful thing it is. An avenue is a very beautiful thing. But there are many streets far too narrow to take an avenue, and yet it is quite possible that there may be a situation at one or both ends where a tree or a clump of trees can be put; and picture the difference such a clump, changing in colour with the season, will make to the amenity of the street. Or there may be one or more small gardens where small trees or bushes and flowering shrubs might be grown, where bright green grass bands or plots may be put, and which if kept in order can be maintained bright and beautiful. Such clumps and bushes and grass bands and plots are, we know, the natural concomitant of the homes of the more well-to-do portion of the community. But so are they often the accompaniments of the better parts of the city and town. On the Continent, for instance, you do not

want for beauty in the fine boulevards to be found in Paris or Brussels; the Unter den Linden is a thing of beauty in spring in Berlin, whilst the famous Ring of Vienna is as fine a piece of city tree decoration as you could wish to see anywhere.

In these islands we are far behind the Continent so far as the beauty of our streets go. Boulevards as understood on the Continent are entirely absent from most of our big cities. In the exhibition I see on the wall two fine sketches of new proposed roads in Liverpool. These are laid out in the proper spirit, and certainly not one of the least important parts of town planning is the laying out of spacious tree-bordered roads, or even better, because more picturesque, if space is available, with a double line of trees and a walk down the centre of the road, like the Unter den Linden in Berlin. Parks and open spaces we have in our great cities, and very beautiful many of them are. In many cases they are, however, situated at considerable distances from the densely congested poorer parts of the town.

Here in Edinburgh, a city the natural advantages of the setting of which it would be difficult to beat, I can picture George Street as having a very different appearance with a fine green row of trees down each side. I think the addition of a row on the shop side of Princes Street would add beauty to one of the finest streets in Europe, whilst, to mention others, Hanover Street, Frederick Street, and the other streets running off up the slope would look infinitely more picturesque with trees on either side; and once the trees were up they would break the force and chill of the most persistent prevailing wind I have met! But it is not only in the wealthier part of the city that work of this nature should be carried out. Trees should be planted in lines or clumps or as single trees in the poorer and more densely populated quarters of the city. It should not be possible for a child to grow up in any quarter of a city without being in daily contact with trees and plant growth. It should be rendered possible for the town-bred child to know the changes of seasons, not merely by temperature only, but by recognising the early beginnings of life in the year with the first snowdrop, to be followed by the crocus, and shortly after by the budding of the earliest trees. It should be possible for him to know and, if he will, see for himself the trees and other plants flowering and seeding in due season.

It may be said that this will be difficult of realisation in the densely populated poorer quarters of the town. May I tell one more small story which I think points a way?

Some years ago I was stationed in Darjeeling, in the eastern Himalaya. Darjeeling is a town of considerable size, the summer headquarters of the Government of Bengal, and possesses one of the great views of the world, the superb snowy giant Kinchin Junga, to see which and Mount Etna beyond all devout tourists to India make a pilgrimage. The town is situated on a ridge and outlying spurs, the houses embosomed in Cryptomerias, oaks, and other hardwoods. Beautiful as is the place in itself, with its incomparable setting of eternal snows, it came to be recognised that much could be done with the object of beautifying the station. Some of the roads were without trees, the banks and slopes between them overgrown with a tangled jungle growth; the gardens of the houses left much to be desired in many respects; the roads of the bazaar were dirty, and the offshoot paths overgrown with a matted mass of undergrowth, the home and breeding grounds of pestilential flies and microbes. At the instance of the Lieutenant-Governor, the late Sir John Woodburn, K.C.S.I., as fine and broad-minded a type of the British official as could be found anywhere, a motion was set on foot which had for its object identical aims with those, or some of them, the present Town Planning Exhibition is setting before the public—the beautifying of the town so as to render it a better dwelling place for those who had to spend their lives, or a portion of their lives, there. The question, once mooted, was taken up with enthusiasm; and it must be remembered that, as in Quetta, the population concerned mainly consisted of men who would only pass an uncertain number of years in the station, a transfer or final retirement home ending their connection with it. In Darjeeling a strong committee was formed, on which the Government, the municipality, the local bar, merchants, house owners, and private individuals, British and Indian alike, were represented.

The Government recognised, as was pointed out by the Lord Provost at Lord Pentland's speech the other day, that it was not to the municipality (that is, corporation or town council) alone that it should look for the carrying out of the scheme—that the whole responsibility did not rest with the municipality alone. Whilst recognising the necessity of the municipality being the first to move in the matter and promise its support, it was pointed out that every householder in the town had equally a duty to perform in aiding the scheme, and that no scheme could be complete or effectual unless each householder recognised such duty and was prepared to give solid help to further the ends in view. Donations and aid were asked for by the committee from the Government, municipality, and also from the householders, and were forthcoming from each quarter. The committee then proceeded to lay down in broad general lines its recommendations for giving effect to Sir John Woodburn's ideas, and these recommendations dealt with the widening of roads, constructing new roads, building up retaining walls to keep up banks and slopes, planting trees either as avenues or in groups or single trees, the pruning of existing trees which required such work, cutting unsightly undergrowth from banks and slopes and grassing such, cleaning up the gardens of such householders as could not afford to do the work, and in making provision for giving out seed or trees and shrubs where necessary.

The broad principles of the work having been laid down, a strong working committee was appointed, and the whole of the work done in the station in the year I am dealing with was done by that working committee. Householders who were well off were asked to consult personally the working committee as to the details of the improvements to be carried out in their own gardens in so far as they affected the external appearance of the town, and to carry out the recommendations made themselves. They were also asked to aid the working committee by donating seed and plants to be planted in the gardens of the poorer classes. This work was done by the staff of the working committee, and under the personal superintendence of the latter. It was a common sight during that spring, summer, and autumn to see members of the committee supervising work for a couple of hours before breakfast in the morning, men who would be spending the rest of the day in their offices engaged in their ordinary daily pursuits. As a result, the improvement in the appearance of the station was astounding, and fully repaid the time and labour spent on it.

I have quoted this example at some length because it shows that the question of the improvement of a town, and more especially the poorer and more squalid parts of a town, is no Utopian scheme. It should be quite possible to institute similar committees in every large city and town of this country. In the case of the larger ones, such as London, for instance, each local district could have its own local working committee once the broad lines of policy had been laid down.

Here in Edinburgh a working planting subcommittee of the town planning committee might be formed to look after the beautifying of the city so far as such could be advanced by planting work. For the poorer quarters of the town a definite scheme of planting, by which I mean not only the planting of trees and shrubs, but also the formation and upkeep of grass and flowers, should be laid down and worked up too, as funds allowed, it being a *sine qua non* that only such work should be taken in hand as could be looked after and kept up in years to come. To plant a row or avenue of trees and then leave it to take its chance, usually an extremely poor one, of reaching maturity, is to throw away good money. Similarly, to plant areas of grass and leave them to become refuse and rubbish heaps or mud flats is merely to add to the squalor and untidiness of a neighbourhood. For the dwellings of the wealthier inhabitants, advice would be offered when demanded or suggestions made when it was desired to obtain uniformity of treatment in a particular locality or neighbourhood, or when the planting of a group of trees in a garden would afford a pleasing amenity for a neighbouring poorer locality. In the public streets the subcommittee should be given a free hand so far as

tree planting and the formation of grass plots went. I have mentioned above how a street such as George Street, for instance, which has great breadth, could be beautified by an avenue of trees such as black poplars, or sycamores, or elms. In other parts of the city, horticulturists are of opinion that thorns and the service tree might be used, whilst in sheltered situations I should like to try the plane, lime, and even the horse-chestnut. I should like to go into greater detail on what might be attempted in Edinburgh on this head, but for one thing time will not permit of it, and for the other I should require to make a closer survey of the city in this respect than I have yet had opportunity to do.

There is one other point, however, in connection with tree planting in towns which applies alike to Edinburgh and all growing cities and towns. It is concerned, not with tree planting, but with tree felling. It is difficult to speak too strongly in disapprobation of the indiscriminate and pernicious felling of trees which usually takes place when a new block of houses is to be built or a new road laid down. No effort is made to first mark out the foundations or alignment to ascertain whether the trees must come down or can be left to afford a pleasing amenity to the district. Perhaps for the gain of a few shillings or through ignorance or gross stupidity they are ruthlessly hacked down, a few hours destroying the work of a century, and the stumps remain a lasting source of regret to those inhabiting the district, for they can never hope in their time to replace the trees so mercilessly destroyed.

The first rule for a town planning committee to lay down should be that no trees on areas in which building extensions are to take place should be felled or killed without a special permission being previously obtained.

In conclusion, I could wish to point one moral with no uncertain note, and that is the great effect on the amenity of a district and on its inhabitants which tree growth exerts. A barren country is depressing, and has a like effect on mankind, resulting in the coarsening of human nature. Can one be surprised at the low scale of morality and the absence of the finer instincts of human nature generally associated with coal-mining districts when one remembers that alike above and below the surface of the earth the miner finds everything black and lifeless? To merely travel through such a country is depressing. How much more so to live in it? And as it is with the Black Country, as it is called, so is it in the narrow street of the slums, where the blue sky is hidden by the smoke of the great city and plant life of all kinds is absent.

Give the people better homes to live in—it is a first desideratum—but with the houses give them the companions of their ancestors, the trees, the green grass, and the flowers, for there are species of each which, if properly looked after, will grow even in the murk of the great city.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—The Senate at its meeting on March 29 accepted the Galton bequest, and authorised the issue of an appeal for 15,000*l.* to defray the cost of the erection and equipment of a suitable building for the Eugenics Laboratory. Hitherto the laboratory has been housed in the applied mathematics department at University College.

The D.Sc. degree in chemistry was granted to Mr. T. P. Hilditch, an internal student of University College, for a thesis on the relation between chemical constitution and optical activity and other papers; and the degree of D.Sc. in geology was granted to Mr. A. M. Finlayson, an internal student of the Royal College of Science, for a thesis on the geology of ore deposits.

Dr. W. P. Herringham takes the place of Dr. H. A. Caley as a representative of the faculty of medicine on the Senate.

Sheffield.—The council has made the following appointments, among others:—Mr. R. J. Pye-Smith, as emeritus professor of surgery; Mr. Arthur M. Connell, to the lectureship in surgery, which was rendered vacant through Dr. Sinclair White's appointment to the professorship of surgery; and Mr. J. D. Fiddes to the demonstratorship in anatomy.

Prof. Beattie has been appointed representative of the University at the celebration of the 500th anniversary of the foundation of the University of St. Andrews, to be held on September 12–15.

Dr. Alexander Smith has been appointed to the Mitchell chair of chemistry in Columbia University, New York, vacant by the retirement of Dr. C. F. Chandler. He is a Scotsman by birth, and graduated at Edinburgh in 1886. For a short time he was an assistant in chemistry at his *alma mater*. In 1890 he went to America, and has since held professorial posts at Wabash College and the University of Chicago. He is president of the American Chemical Society.

The Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, and Sheffield has arranged to examine pupils in the housewifery forms of girls' schools. The examination will be suitable for girls of sixteen years of age and upwards who have studied domestic subjects up to the standard of the school certificate examination. Candidates must offer, in addition to certain other subjects, elementary general science and cookery and two of the following:—housewifery, laundry, needlework and drawing, elementary biology. There will be a practical examination in all domestic subjects.

In *The Economic Journal* for March Mr. W. M. J. Williams deals with the subject of Exchequer grants, and establishes the need of inquisition and action upon the relation of national to local taxation. He urges that a term should be assigned to grants from the Exchequer, that a delimitation should be made of present grants, and that the whole should be settled with a due regard to economy and care by local authorities. Taking the education grants as an example, he considers the problem of a settlement of the relation to be established between national and local finance. We may assume, he says, that the cost of education publicly provided in the United Kingdom is about twenty-seven to thirty millions sterling. Some one half is derived from national sources, and one half of the cost is borne by local authorities, but in addition the central authority bears the cost of central administration and of grants to educational institutions of various kinds. The quota of the cost borne by taxes has grown very considerably since 1870, and local authorities demand that all education charges shall be borne by the Exchequer. In another place he points out that the same public local authority gets sums of money for educational purposes from two departments of State. Altogether, he makes out a strong case for the separation of national and local taxation and finance.

The Legislature of the State of Utah, during its recent session, made an appropriation of 60,000*l.* to the State University for the construction of the main building of the institution. This building is, says *Science*, to house the general library, the art gallery, and the administrative offices. The Legislature also passed a Bill, which has become a law, putting the support of the university and the agricultural college on a permanent financial basis. At present the annual income of the university for general maintenance is about 40,000*l.* New buildings and other constructions are to be provided by special appropriations. The Legislature of Indiana has, we learn from the same source, appropriated nearly 40,000*l.* to Indiana University for the next biennium. This grant includes 30,000*l.* additional maintenance. According to the American Press, a graduate of the Philadelphia College of Pharmacy, whose name has been withheld, has offered to give 200,000*l.* toward the erection of a comprehensive group of three buildings, one of which shall be specially devoted to research work, for the institution. *Science* also records that Mrs. Benjamin Hicks, of Old Westbury, N.Y., has bequeathed 20,000*l.* to Swarthmore College, and that Columbia University has received the sum of 138,600*l.* from the executors of the estate of the late Mr. George Crocker, for the establishment of the Crocker Cancer Research Fund.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 30.—Sir Archibald Geikie, K.C.B., president, in the chair.—Captain A. G. **McKendrick**: The chemical dynamics of serum reactions. (1) Amboceptor and complement are opposed in their action on the cell, with the proviso that the former acts as a catalyst to the latter. (2) Complement action is lytic; amboceptoral action is primarily polymerising, or, as the case may be, agglutinative, and secondarily catalytic to complement. (3) The relation of these substances is expressed by the law of mass action, in the form

$$\frac{dz}{dt}=\frac{y}{c}\left(\frac{x}{cz}-z\right)-\left(\frac{y}{c}-z\right)^2.$$

(4) When the substance acted upon is in sufficient quantity this expression describes all serum reactions, viz. hæmolysis, bacteriolysis, opsonin and stimulin reactions, agglutination, precipitation, and toxin action. (5) Toxins are compound, and consist of amboceptor and complement.—G. J. **Burch**: Preliminary note on a method of measuring colour-sensations by intermittent light, with description of an unfinished apparatus for the purpose. Briefly, the new method of measuring colour-sensations is as follows:—A series of flashes of monochromatic light produce by a real induction a condition of colour-blindness in a small area of the field of view, which they surround, but do not invade. This small area is occupied, also in flashes properly timed and proportioned, by the part of the spectrum under examination. The colour corresponding to that of the monochromatic flashes is, as it were, wiped out of it, and the observer sees the boundaries of the underlying colour-sensations so long as the flashes succeed one another at the proper rate.—Dr. E. W. Ainley **Walker**: Variation and adaptation in bacteria, illustrated by observations upon streptococci; with special reference to the value of fermentation tests as applied to these organisms. Numerous attempts have been made to differentiate and to identify varieties of bacteria by means of chemical reactions produced by them in special culture media. One of the most interesting of these attempts was that made by Gordon to prove the existence of definite varieties among streptococci by the use of certain test media. Gordon and those who followed him believe that they can thus subdivide the streptococci into a number of fixed and independent varieties, and classify them into what Andrewes and Horder have spoken of as "provisional species." Their conclusions, however, could only be accepted were it proved beyond question that the reactions on which they rely are stable in character and exhibit constancy. In the present communication evidence is adduced from an extended examination of particular strains of streptococci that the reactions concerned are by no means constant. Under the conditions of ordinary cultivation in agar jelly, and still more under culture in the environment supplied by special media, particular strains of streptococci are shown to exhibit wide variations in their reactions to Gordon's test media. Thus it occurs that strains which are at one time totally different in their test reactions may at another time be found to be identical. Further, it appears that after suitable manipulation particular strains may be made to assume the characters now of one, now of another, of the types supposed to be differentiated by Gordon's tests. The conclusion drawn is that no evidence exists of any fixed or specific differences among streptococci pathogenic for man, but that the differences observed are due to merely temporary and casual variations in the metabolism of these micro-organisms, which thus readily adapt themselves to changed environment. Accordingly it is quite possible that suitably selected tests may be made to afford some valuable indication as to the probable habitat or recent environment of any given strain of streptococci.—W. **Bateson** and R. C. **Punnett**: The interrelations of genetic factors. In the sweet pea it was early found that the distribution of factors among the gametes of plants heterozygous for more than one pair was liable to disturbances of two kinds, known as coupling and repulsion ("spurious allelomorphism"). Coupling affects the factors B, blue, and L, long problem, in such a way that the gametic system is

7 BL : 1 B*l* : 1 *b*L : 7 *bl*.

Other factors may be coupled in systems 15 : 1 : 1 : 15; 63 : 1 : 1 : 63; 127 : 1 : 1 : 127; and presumably other systems of numbers similarly related will be discovered. Repulsion was first seen in the case of B, blue, and E, erect standard, acting in such a way that the gametes are all either B*e* or *b*E. Such repulsion has since been recognised elsewhere both in plants and animals, affecting especially the factor for femalemes. Subsequently it was observed (sweet pea) that two factors, viz. that for dark axil and that for fertile anthers, which had previously been found coupled together, might in another family repel each other. As the result of a long series of experiments, it has been established that if A and B be two factors liable to such disturbances, the F_2 from A*b*×*a*B (or reciprocal) shows repulsion between A and B, but the F_2 from *ab*×AB (or reciprocal) shows coupling between A and B. Two kinds of heterozygote can therefore be recognised, which may be represented as A*b*.*a*B and *ab*.AB. The first, on segregation, makes two types of germ-cell A*b* and *a*B; the second makes four, AB, A*b*, *a*B, and *ab*, with *ab* and AB represented in one of the numbers 7, 15, &c. The polarity of the zygote-cell must therefore be influenced by the way in which the factors come into it, and presumably by the positions which they occupy. The *triple* system, B, L, E, in the sweet pea has only been partially investigated, but it is known that E*bl*×*e*BL gives B and L coupled, with repulsion between B and E, not between B and L. An order of precedence between factors must thus be recognised, which possibly is that of the system of coupling to which they are subject.—Philippe **de Vilmorin** and W. **Bateson**: A case of gametic coupling in Pisum. A variety of culinary pea has for some time been grown at Verrières-le-Buisson having leaflets in place of the ordinary tendrils; this condition is recessive to the normal. The variety has wrinkled seeds. Crossed with a round-seeded normal pea, F_2 showed coupling between the factor for tendrils (T) and the factor for round seeds (R), the coupling being according to the system

63 RT : 1 R*t* : 1 *r*T : 63 *rt*.

Coupling has not previously been observed in Pisum. Owing to the fact that the seed-characters are not quite sharp, the nature of the starch was determined microscopically for each seed before it was sown. This work was carried out on a large scale by Miss C. Pellew at the John Innes Horticultural Institution.—R. P. **Gregory**: Gametic coupling and repulsion in *Primula sinensis*. In *P. sinensis* the short style is dominant to the long style, and the magenta colour of the flowers is dominant to the red colour. A series of experiments was made in which a short-styled race having red flowers was mated with various long-styled plants carrying the magenta-factor. It was found that in the gametogenesis of the hybrid so produced complete *repulsion* took place between the factor for short style and that for magenta colour. Subsequently another series of experiments was made in which short-styled plants carrying the magenta-factor were mated with long-styled reds. It was found that when the cross was made in this way *partial coupling* occurred between the factors for the two dominant characters.

Royal Microscopical Society, March 15.—Mr. H. G Plimmer, F.R.S., president, in the chair.—Dr. Ralph **Vincent**: Some photomicrographs illustrating the morphology of the organisms concerned in the production of acute intestinal toxæmia in infants. These included *B. subtilis*, *B. mesentericus* "No. 7," *B. m. vulgatus*, and *B. proteus vulgaris*. The photographs showed the organisms stained, unstained, and during life. Photographs were also shown of the *Streptococcus lacticus*, the *Bacillus acidi lactici*, and the *B. bulgaricus*.—E. M. **Nelson**: A new piece of apparatus. This consisted of an objective mount fitted with an iris diaphragm, in which the iris was just clear of the back lens, and its movement was controlled by a collar adjustment. The apparatus would no doubt be of great value to workers who employ dark ground for viewing bacteria, &c., as in many instances, owing to defects in the dark-ground illuminator, it was not possible to obtain a dark field when the objective had a wide angle. This fault was remedied by stopping down the aperture of the objective by means of the diaphragm.—E. M. **Nelson**: New objec-

tives and eye-pieces made by R. Winkel, of Göttingen.—J. **Murray**: Report on the rotifers collected by the British Antarctic Expedition of 1909. Forty-six Bdelloids were collected, bringing the Australian list up to fifty-four species. There were seven new species, and eight others occurred as distinct varieties. The new species were *Philodina australis, Callidina armillata, lepida, longistyla, serrulata, mirabilis*, and *Habrotrocha strangulata*. The most aberrant form was *Callidina mirabilis*, which had peculiar fleshy processes on the trunk. The rotifera fauna of the Australian Alps resembled that of Britain. The arid lowlands were very unproductive. Three-fourths of the species, and all the new species, occurred in the Blue Mountains, of moderate elevation. Eight species of non-Bdelloid rotifera were also noted from the water supply and ponds in Sydney.

Zoological Society, March 21.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Mrs. E. W. **Sexton**: The amphipod genus Leptocheirus. In preparing this revision of the genus, the type-specimens of nearly all the species had been examined. The author found that in some cases different stages of growth had been described by different authors as distinct species, in other cases the inadequacy of the original descriptions and figures had led to the introduction of a number of unnecessary synonyms. The specimens of Zaddach's *L. pilosus* and Grubbe's *L. guttatus* had been examined and redescribed, and the number of valid species in the genus was now seven, namely, *L. pilosus, L. pinguis, L. hirsutimanus, L. pectinatus, L. guttatus, L. aberrans*, and *L. bispinosus*.—J. Lewis **Bonhote** and F. W. **Smalley**: Inheritance of colour in pigeons. The paper dealt with the first results of a long series of experiments. Although chiefly Mendelian in character, the authors laid stress on the fact that in several respects their results seemed to point to a further law or laws, which were able to modify the expected Mendelian results, and in regard to which the Mendelian theory offered no satisfactory solution. They showed, for instance, that in chequer and blue matings there was a regular tendency to an over-production of chequers; in the grizzle matings the tendency was to an over-production of blues. Another point apparently inexplicable on the Mendelian hypothesis was the difference in shades of the same colour; by disregarding these and considering them all as gametically identical, the results gave approximately the expected proportions, but, on the other hand, the shades of the different birds undoubtedly affected their progeny, and hence the gametes must also have been affected. The preponderance of a certain sex in a particular colour was also noted, as well as an increase of white in successive generations. No explanation of these phenomena was put forward, as further experiments were still in progress. In dealing with the purely Mendelian aspect of the results, the following points were clearly brought forward:—(1) silver is dilute blue; (2) blue is dominant to silver; (3) chequering and grizzling are both dominant to absence of pattern; (4) grizzling is dominant to chequering; (5) a mealy is a grizzled bird with the white replaced entirely or partially by red; (6) red in a mealy is dominant to white, hence a mealy is dominant to a grizzle; (7) white and grizzling combine to have a common inheritance; (8) red combines with grizzling in the same way as white.—Dr. G. Stewardson **Brady**: Marine ostracoda from Madeira, based on specimens collected by the Rev. Canon Norman, F.R.S., in the spring of 1897. Apart from the species described as new to science, the collection was interesting as extending the known range of several species from the European and North Atlantic areas much farther southward, though not quite into the tropical zone.

Edinburgh.

Royal Society, February 6.—Dr. Burgess, vice-president, in the chair.—W. **Watson**: The isopiestic expansibility of water at high temperatures and pressures. The water contained a small quantity of hydrochloric acid. The apparatus employed was the high-temperature compression cylinder described by Prof. Des Coudres in the Leipzig *Berichten* of July, 1910. The volume change was measured by a method modelled on the electrical methods of Tait, Amagat, and Richards. The dilatometer was made of quartz glass. It was found that, soon after the critical temperature was passed, water behaved for all pressures investigated as an ideal gas, inasmuch as the isopiestics became straight lines. At 400 atmospheres and a range of temperatures from 400° to 500° C., the mean coefficient of expansion of water substance was found to be of the order 0·043. Amagat, working between 100° and 200° C., obtained 0·00099.—H. **Briggs**: An investigation into the effects of errors in surveying. The paper discussed the effects of errors in linear and angular measurements on the accuracy of surveys. A fundamental theorem was that concerning the sum of vector errors, viz. the average error in the position of a point influenced by two or more vector errors is equal to the square root of the sum of the squares of the average magnitudes of the vector errors, and is independent of their relative clinures. Many of the results and methods given are believed by the author to be new. Among these may be mentioned the conclusion that the best theoretical shape of a triangle for triangulation is an isosceles one with an apical angle of 67° 30′. The angle may, however, vary between 50° and 90° without appreciably affecting the well-conditioned character of the triangle, and other reasons lead to the selection of the equilateral triangle as the best for practical purposes.—Dr. W. H. **Young**: Fourier's repeated integral, and on Sommerfeld's form of Fourier's repeated integral.

February 20.—Dr. Horne, F.R.S., vice-president, in the chair.—Miss Dorothy **Court**: The determination of small degrees of enzymatic peptolysis. Abderhalden's method for studying enzymatic peptolysis by allowing the enzyme preparation to act on a solution of pepton prepared from silk and observing the precipitation of tyrosin, is limited in its application by the impossibility in many cases of using clear solutions and by the fact that insoluble products other than tyrosin may be formed as a result of the action. These difficulties are overcome by the filtration of the products of the reaction, and treating the residue on the filter, after drying, with dilute sulphuric acid, and subsequent addition to this filtrate of formol and concentrated sulphuric acid (Mörner's reagent). In the presence of tyrosin a green colour is produced, and the quantity of tyrosin, and thereby the degree of peptolysis, may be estimated by measuring the intensity of this colour by means of the tintometer.—Dr. David **Ellis**: Concerning the new genus of iron bacteria, *Spirophyllum ferrugineum* (Ellis). In this paper, which was a continuation of a former paper, the author met the criticism of Prof. Molisch that Spirophyllum was not generically distinct from Gallionella. In addition to further descriptions, the paper contained some excellent photomicrograms.—Principal A. P. **Laurie**: The temperature coefficient of concentration cells, in which the same salt is dissolved in two different solvents. In addition to the series of experiments described, the paper gave a full discussion of the relationship between the electromotive forces of water and alcohol cells, their thermal properties, and the precipitation of salts by alcohol.

March 6.—Prof. Crum Brown, vice-president, in the chair.—J. P. **Dalton**: The accuracy attainable with a modified form of Atwood's machine. The modification consisted in making one side of the spindle of ebonite, so that as the wheel revolved electrical contact between the two sides of the apparatus became intermittent. By connection with a chronograph, records of distance fallen through and time taken were obtained. The frictional retardation could be determined with great accuracy. The mean of eight different determinations of g gave 980 cm./sec.^{2}, the greatest deviation from the mean being 0·5 per cent. It is probable that a still greater accuracy could be attained with more carefully constructed apparatus than was at the disposal of the author.—J. B. **Ritchie**: The dissipation of energy in torsionally oscillating wires, with the effects produced on the law of torsional oscillations by change of temperature. Peddie's empirical formula $y(x+a)=b$ was applied to the case of wires of brass and other materials, and found to represent the results accurately over a large range of oscillation. The effects of heating were studied fully for brass, aluminium, and copper. In certain cases a sudden change in the value of the constant n was experienced, this change suggesting that a different molecular arrangement was produced at certain definite temperatures. The hardening of the wires

by stretching also produced definite changes in the value of the constants.—J. B. **Ritchie**: An apparatus for inducing fatigue in wires by means of repeated extensional and rotational strains, with the effects produced by such fatigue on the laws of torsional oscillations. The apparatus, designed by Prof. Peddie, is primarily an oscillating pendulum of large moment of inertia electrically maintained, and is provided with an automatic contact breaker. Rotational fatigue was found to have no effect upon the constants in the oscillation equation for brass wire.—Dr. Thomas **Muir**: Boole's unisignant.

MANCHESTER.

Literary and Philosophical Society, March 7.—Mr. Francis Jones, president, in the chair.—Prof. E. **Rutherford**: The scattering of the α and β rays and the structure of the atom. From a consideration of general results on scattering by different materials, the central charge of the atom is found to be very nearly proportional to its atomic weight. The exact value of the central charge has not been determined, but for an atom of gold it corresponds to about 100 unit charges. From a comparison of the theories of large and small scattering, it is concluded that the effects are mainly controlled by the large scattering, especially when the fraction of the number of particles scattered through considerable angles is small. The results obtained by Crowther are for the most part explained by this theory of large scattering, although no doubt they are to a certain extent influenced by small scattering. It is concluded that for different materials the fraction of particles scattered through a large angle is proportional to NA^2, where N is the number of atoms per unit volume and A the atomic weight of the material. The main results of large scattering are independent of whether the central charge is positive or negative. It has not yet been found possible to settle this question of sign with certainty. This theory has been found useful in explaining a number of results connected with the scattering and absorption of α and β particles by matter. The main deductions from the theory are at present under examination, in the case of the α rays, by Dr. Geiger, using the scintillation method.—Dr. H. **Geiger**: The large scattering of the α particles. Geiger and Marsden have shown that a small fraction of the α particles incident on a thin film of matter are so scattered that they emerge again on the side of incidence. In the present paper the fraction of the α particles scattered through various large angles by a thin gold foil has been experimentally determined by the scintillation method. Radium emanation enclosed in a fine glass tube was used as a source. The microscope to which the zinc sulphide screen was attached moved round the arc of a circle; the distance between the scattering material and the screen was constant and equal to about 2 cm. The source of radiation, the scattering foil, and the screen were enclosed in a metal vessel, which was exhausted to a low pressure. The number of α particles scattered through large angles up to 150° was first measured, and, as the emanation decayed, the number of small angles was successively determined. The number of scattered particles per unit area varied, when corrected for decay, nearly 300 times over the range of angles examined. The actual numbers of particles observed varied very approximately as $\operatorname{cosec}^4 \phi/2$, where ϕ is the angle of deflection. This is the relation theoretically deduced by Prof. Rutherford in the foregoing paper.—R. F. **Gwyther**: Can the parts of a heavy body be supported by their elastic reactions only?

PARIS.

Academy of Sciences, March 27.—M. Armand Gautier in the chair.—The president announced the death of S. Arloing, correspondant in the section of rural economy.—A. **Lacroix**: The peridotites of New Caledonia.—A. **Müntz** and E. **Laine**: The nitrogen losses during the purification of sewage by bacterial beds. It has been shown in previous papers that the nitrogen losses average 50 to 60 per cent. The present note deals with the forms in which the nitrogen escapes. If organic matter is absent and the nitrogen is present as ammonia salt, no loss occurs, but the losses increase with the proportion of organic matter present. It has been found that the nitrates are reduced to gaseous nitrogen.—Pierre **Termier**: The mylonites of the island of Elba. The existence of these rocks in Elba points to a general and intense crushing action, and leads to a new interpretation of the structure of the island.—J. **Carpentier**: A tension meter, for measuring the pull exerted by metallic wires in aëroplanes.—C. **Guichard**: The C networks, such that the lines of a series should be plane curves.—F. **Gonnessiat**: D'Arrest's comet. A discussion as to the cause of the increase of intensity of luminosity over that calculated according to the law of inverse squares.—Henri **Lebesgue**: The invariance of the number of dimensions of a space and on Jordan's theorem relating to closed varieties.—Georges **Léry**: Green's function for an algebraic contour.—Maurice **Fréchet**: The notion of a differential.—André **Broca**: The constitution of axes of rotation sufficiently stable to permit the measurement of the geodesic angles by the method of repetition.—Félix **Michaud**: The causes which may produce the variation, at constant temperature, of the vapour pressure of a liquid. The curvature of the meniscus is not the direct cause of the capillary variation of vapour pressure.—E. **Henriot**: The radiations of the alkaline metals. Potassium salts emit a very penetrating ionising radiation, that from rubidium salts being less penetrating but more intense. Cæsium salts give no appreciable ionisation, an unexpected result. The causes of the marked differences between the radiation of the metals and their salts is discussed.—A. **Leduc**: Application of principles to a case of magnetostriction.—M. **de Broglie** and L. **Brizard**: The mobility of the ions produced in air by the hydration of sulphate of quinine. The ionisation of air produced by this salt belongs to the type of rapid recombination, and the measurement of the mobility of these ions presents special difficulties. The present note describes how these difficulties have been overcome.—Maurice **Joly**: A static means of tripling the frequency of alternating currents.—Maurice **Coste**: The metallography of the gold-tellurium system. Details are given of the methods adopted for purifying the tellurium and preparing the alloys. Only one compound appears to be formed, $AuTe_2$, and there is direct evidence against the formation of the compound Au_2Te of Margottet.—P. **Pascal**: Magneto-chemical researches on the atomic structure of the halogens.—Ath. I. **Sofianopoulos**: Two new compounds of stannous chloride with ammonia.—E. **Dumesnil**: The preparation of an arsenic amalgam. Arsenic amalgam is obtained by reducing a solution of arsenious acid and mercury bichloride in hydrochloric acid by sodium hypophosphite. The composition of the amalgam corresponded to As_2Hg_3.—Alexandre **Hébert**: The pyrogenous decomposition of the metallic xanthates. Eleven metallic xanthates have been examined, and a table is given showing the nature and amount of the gaseous and liquid products. The canthates of nickel and mercury give the ester $C_2H_5O.CS.SC_2H_5$ in good yields.—Léo **Vignon**: The action of water vapour upon carbon in presence of lime. The principal gaseous products are hydrogen and methane, together with carbon monoxide and dioxide, oxygen, and nitrogen.—Paul **Lebeau**: Some definite bismuthides. Remarks on a recent paper by A. G. Vournasos on a method of preparing sodium bismuthide.—L. **Hackspill** and R. **Bossuet**: The temperature at which water is attacked by the alkaline metals. The globule of the metal, previously distilled in a vacuum, and with a perfectly bright surface, is cooled to a given temperature, and water vapour allowed to condense on the metal; the alteration of pressure caused by the evolution of hydrogen indicates the reaction. Cæsium is attacked at −116° C., rubidium at −108°, potassium at −105°, and sodium at −98°. It would appear that the reaction is between metal and vapour, and not metal and solid ice.—Marcel **Guichard**: The gases given off by the walls of glass, porcelain, and silica tubes. Jena glass gave about 0·03 c.c. of gas per 100 sq. cm. of surface; with porcelain the results were variable, but the quantity was about three times that of the Jena glass. Fused silica gave as much as 2 c.c. of gas per 100 sq. cm. surface.—M. **Lespieau**: A method of preparing certain true acetylenic alcohols. The method indicated in a previous communication, based on the action of methylmagnesium bromide upon monobromacrolein, has been generalised, and additional acetylenic alcohols are described.—M. **Godchot** and F. **Taboury**: The catalytic addition of hydrogen to cyclopentanone. The products of the reaction

are cyclopentane, cyclopentanol, and a compound $C_{10}H_{16}O$, isomeric with camphor, formed by the interaction of two molecules of the cyclopentanone and one molecule of hydrogen.—L. **Duparc** and M. **Wunder**: The serpentines of Krebet-Salatim (North Ural).—MM. **Tschirch** and **Ravasini**: The wild fig in its relations to certain types of cultivated fig.—François **Kövessi**: New researches on the supposed utilisation of nitrogen from the air by certain special organs of plants. The development of the specialised organs studied by Jamieson, Zemplen, and Roth is not interfered with by the complete absence of gaseous nitrogen, and hence cannot be regarded as causing the assimilation of this gas.—M. **Desroche**: The phototropism of the zoospores of *Chlamydomonas Steinii*.—A. **Desgrez** and F. **Calus**: The ptomaines of tinned fish and crustacea. All the samples examined contained ptomaines in proportions between 0·2 to 0·6 gram per kilogram. The bases thus isolated are relatively slightly toxic.—Jean **Gautrelet** and Louis **Thomas**: The influence of the ablation of the suprarenals on the nervous system.—Jules **Glover**: Classification of the voice.—MM. **Bordas** and **Touplain**: Considerations on the estimation of phosphate in the ash of milk. No phosphorus is lost in reducing milk to an ash.—Gabriel **Bertrand** and M. **Javillier**: The combined influence of zinc and manganese on the development of *Aspergillus niger*.—L. **Massol**: The action of ultra-violet light upon starch. Under the influence of rays from a quartz mercury lamp, starch loses its property of bluing with iodine, and the solution acquires reducing properties.—R. **Bierry**: The digestive ferments of the hexotrioses and of stachyose.—E. **Brumpt**: The decimation of the stags of the forest of Chantilly by worms.—E. L. **Trouessart**: The Indian wolf, *Canis pallipes*, and its relations to the domestic dog.—E. **Sollaud**: *Desmocaris trispinosus*, a type of a new genus.—MM. **Grenet** and **Salimbeni**: The resistance opposed to the passage of micro-organisms by filtering candles with collodion layer.—E. **Bataillon**: The two factors of traumatic parthenogenesis in amphibians.—Armand **Dehorne**: The non-copulation of the exchanged nucleus and of the stationary nucleus, and the disappearance of the latter in the conjugation of *Paramecium caudatum*.—Stanislas **Meunier**: The otogenic efficacity of earthquakes.—A. **Briquet**: The morphology of the Gallo-Belgic littoral.—Ph. **Négris**: The discovery of Eocene breccia in Greece and their importance.—Jean **Brunhes**: The confusion produced by the use of the morphological pseudo-term "cala."—Ch. **Moureu** and Ad. **Lepape**: The constancy of the ratio of krypton to argon in natural gaseous mixtures. This ratio was measured in twenty gases of natural origin, and was found to be nearly constant.

DIARY OF SOCIETIES.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: A Chemically-active Modification of Nitrogen produced by the Electric Discharge: Hon. R. J. Strutt, F.R.S.—Papers: The Association of Lead with Uranium in Rock-minerals, and its Application to the Measurement of Geological Time: A. Holmes.—The Path of an Electron in Combined Radial Magnetic and Electric Fields: Dr. H. S. Allen.—On the Dynamical Nature of the Molecular Systems which emit Spectra of the Banded Type: Prof. E. T. Whittaker, F.R.S.

ROYAL INSTITUTION, at 3.—Surface Combustion and its Industrial Applications: Prof. W. A. Bone, F.R.S.

LINNEAN SOCIETY, at 8.—On the Brown Seaweeds of the Salt Marsh: Miss S. M. Baker.—On the Genus Salicornia: Dr. C. E. Moss (History, Synonymy, and Phylogeny), E. J. Salisbury (Characters of the Species), and Dr. Ethel de Fraine (Anatomy).

RÖNTGEN SOCIETY (King's College), at 8.15.—Secondary Rays: Prof. Barkla.—An Improvement in High Tension Discharge Apparatus: Prof. Wilson.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—Diesel Engines for Sea-going Vessels: J. T. Milton.—The Influence of Longitudinal Distribution of Weight on the Bending Moments of Ships among Waves: F. H. Alexander.—Considerations affecting Local Strength Calculations of Ships: J. Montgomerie.—At 7.30: The Acceleration in Front of a Propeller: Dr. R. E. Froude, F.R.S.—An Investigation into the Stresses in a Screw Propeller Blade: Engineer-Lieutenant A. Turner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Wireless Telegraphy Working in Relation to Interferences and Perturbations: J. E. Taylor.

FRIDAY, APRIL 7.

ROYAL INSTITUTION, at 9.—A New Method of Chemical Analysis: Sir J. J. Thomson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—A List of Marine Shells occurring at Christmas Island, Indian Ocean, with Description of New Species: E. A. Smith.—Description of *Oxytes Beddomei*, n. sp., from Burma: Lt.-Col. H. H. Godwin-Austen, F.R.S.—Note on the Habits of *Eurychlamys platychlamys*: Major A. J. Peile, R.A.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—Results of Trials of the Anti-rolling Tanks at Sea: Dr. H. Frahm.—Steering-gear Experiments on the Turbine Yacht *Albion*: H. S. Hele-Shaw, F.R.S., and F. L. Martineau.—Description of a Stability and Trim Calculator: S. B. Ralston.—General Propositions and Diagrams relating to the Balancing of the Four-cylinder Marine Engine: C. E. Inglis.—At 7.30: The Determination, by Photo-elastic Methods, of the Distribution of Stress in Ships' Plating: Prof. E. G. Coker.—Some Notes on a New Design of Merchant Vessel: M. Ballard.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Retaining Walls: E. F. Farrant.

GEOLOGISTS' ASSOCIATION, at 8.—(1) The Scenery of Gloucestershire; (2) On the Sections of Forest Marble and Great Oolite on the Midland and South-Western Junction Railway between Cirencester and Chedworth, Gloucestershire: L. Richardson.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, APRIL 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—On the Plans of the Australian Antarctic Expedition, 1911–1912: Dr. Douglas Mawson.

TUESDAY, APRIL 11.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Improvement of Highways to meet Modern Conditions of Traffic: J. W. Smith.—Recent Development in Road-traffic, Road-construction and Maintenance: H. P. Maybury.

WEDNESDAY, APRIL 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, APRIL 13, 1911.

PROBLEMS OF SEXUAL AND ASEXUAL REPRODUCTION.

Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. By Prof. E. Korschelt and Prof. K. Heider. Erste und Zweite Auflage, Allgemeiner Theil, Vierte Lieferung. Erste Hälfte. Pp. 167–470. Price 7.50 marks. Zweite Hälfte. Pp. 471–896. Price 11 marks. (Jena: Gustav Fischer, 1910.)

EMBRYOLOGISTS who are already acquainted with the "Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere"—and what embryologist is not?—will welcome with delight the appearance of these further instalments of the "Allgemeiner Theil." No pains have been spared in the preparation of these two volumes, and authors and publishers alike are to be congratulated on their achievement.

In the first the student is introduced to the earliest important phase in the differentiation of the sexually produced individual organism—the formation of those "elementary organs" long since known as the layers of the germ. An admirably lucid account is given of the various types of "gastrulation," or endoderm formation, and this is followed by a description of the development of the mesoderm. The latter part of the treatise is devoted to the study of the peculiarities of these processes in certain special groups, Sponges, Arthropods, and Chordates (Cephalochorda and Urochorda).

It seems almost ungenerous to criticise where the general level of attainment is so high, but we confess that we should have liked to see the Vertebrates included in the last chapter—the method of closure of the blastopore, its relation to the chorda and neural plate are so similar in all these forms—and it is certainly a pity that no attempt has been made to deal with the derivation of the Amniote from the conditions found in Anamnia—a problem long the despair of embryologists, but now happily solved with the help of the Gymnophiona. And we might venture to remark perhaps that Fig. 154A, on p. 248, is incorrect in not exhibiting the bilateral structure of the egg, due to the formation of the gray-crescent on fertilisation. These, however, are matters that hardly mar the excellence of the book.

The second volume makes even more fascinating reading. One by one we are shown, in the groups of the animal kingdom, the details of the mechanism by which a new individual is produced from a bud, processes simple enough in some cases, but often presenting the most amazing complexities, which reach their acme in the Ascidians, while at the same time they defy—notably in Polyzoa and Ascidians again—the rules observed in sexual reproduction, and challenge the observer to frame any formula which will embrace the infinite variety of their behaviour.

But description is but the beginning of embryology, as of any other science, and the baffling problems presented by the germinal layers will assuredly only yield, if at all, to the experimental method. The results which that method has obtained must indeed form the starting point of any discussion, the basis of any theory of the part played by these "elementary organs" in development.

The old germ-layer hypotheses, which all more or less trace their lineage back to Haeckel's famous "Gastræa-Theorie," assume that the stage at which these sets of cells are segregated is of phylogenetic significance, reminiscent of some bygone ancestry, and that there is a general agreement not only in the way in which the layers originate, but also in the structures to which they eventually give rise, as is, of course, necessary for the hypothesis.

And though the authors of this treatise very properly define the germ-layers as the rudiments of definite body tissues in normal development, they are yet concerned to attempt some defence of a position which is no longer tenable.

Even in sexual reproduction there are too many refractory facts: thus, a two-layered condition is not necessarily a separation of endoderm from ectoderm (Placental Mammals, Cestodes, Phylactolæmata), the gut of Cœlenterates is formed in various ways, and so in Vertebrates the roof and floor of the archenteron play varying parts in the formation of that organ, while in those groups in which the egg segments according to the "spiral" type, it is by no means necessary that a cell or cell-group which has a definite place and time of origin in the cleavage system should invariably give rise to the same larval or embryonic part, though, it is true, this usually occurs. The cell 4*d*, for instance, is not always mesoblastic, and even when it does give rise to the mesoblastic bands the destiny of those structures may be variable. In Annelids, the cœlom is developed in them, in certain Mollusca they break up into connective tissue while the (cœlomic) pericardium has another (ectodermal) source.

These are only a few instances. When, however, we turn to the conduct of the layers in budding matters are infinitely worse. In Polyzoa the whole of the alimentary canal is of ectodermal origin; in Turbellarians nervous system and pharynx are mesodermal; in Annelids the pharynx is endodermal, all these organs being in sexual reproduction developed from the ectoderm. In Cephalodiscus the gut is ectodermal instead of being derived from the parental endoderm. In the Tunicata these anomalies attain the perfection of irregularity. The nervous system may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma*, Salps, Doliolidæ). The atrium may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma*, Salps), while the pharynx may be ectodermal (Botryllidæ, Doliolidæ), or endodermal (other Ascidians).

These facts, as the authors admit, nay insist, are indisputable, and absolutely irreconcilable with the requirements of the ordinary germ-layer theory.

An effort is indeed made to save the situation by minimising the discrepancies that occur in the course of sexual reproduction, and removing the facts of

budding to another category. The writers, in fact, suggest that the phenomena are not coordinate, and that there would have been no difficulty had not "prospective significance" been confounded with "prospective potentiality." That is, it is the peculiarity of a bud to contain sets of cells which have greater capacities than the embryonic layer from which they were derived in the other manner of development. And yet, when it becomes necessary, to find some general expression for the different modes of endoderm formation in Cœlenterates, to deduce them all from some common origin, the "prospective significance" is enlarged until it is big enough to include as much "potentiality" as may be required!

The truth is that the anomalies are of the same order in both kinds of reproduction. In both the germ-layers have greater potentialities than they normally display, and no theory of them can ever be satisfactory that does not offer a general explanation of their origin and differentiation, in the development of the ovum, in budding, and in regeneration.

To the phenomena of the last two kinds the test of experiment has, as yet, scarcely been applied, but we do fortunately know what the internal factors are on which the differentiation of these first-formed embryonic organs in the ovum depends. For experiment has shown us that there are in the cytoplasm of the unsegmented egg-cell certain substances—at least certain regions—the removal of which entails the absence in later development of some particular embryonic or larval structure. The position of these substances in the ovum need not be that in which the corresponding organ eventually appears (the apical sense organ of *Dentalium* depends on something present in the polar lobe of the egg), and the manner in which this heterogeneous cytoplasm is cut up into cells during cleavage is largely irrelevant, the cleavage pattern being alterable, and, further, determined by other, distinct, causes. Hence, though normally these organ-forming stuffs pass into definite cells, though in related forms the cleavage pattern is alike, but not identical, though in related forms the arrangement of the stuffs and the differentiation of the organs is alike but not identical, nevertheless variations in the cleavage unaccompanied by corresponding variations in the cytoplasmic structure (or the converse), necessarily lead to the production, in related forms, of the same organ from a cell which has in cleavage a distinct origin. The illustration applies primarily to "spiral" cleavages—the nephridia of Leeches comes from 4*d*, of Annelids from 2*d*, the pericardium of some Mollusca from ectoderm, of other Mollusca and of Annelids from mesoderm (4*d*), and so on—but, *mutatis mutandis*, may be easily extended to other cases.

In truth, the substances out of which genuinely homologous, that is, phylogenetically homogeneous organs are developed, must be themselves homologous. They exist in the egg antecedent to segmentation and gastrulation, and cannot be created by those processes, in which therefore we look in vain for any absolute criterion of homology.

What experiment has done for the developing ovum it will, we hope, before long accomplish also for the bud and the regenerating organism. Then, but not until then, shall we know what the internal factors of differentiation are in these cases also, and shall be able perhaps to show that the primary—eventually all—the phenomena of their "increase of structure" are determined by the same kind of material (ultimately physical and chemical constitution), as that on which they are dependent in sexual reproduction.

WEBSTER'S NEW INTERNATIONAL DICTIONARY.

Webster's New International Dictionary of the English Language. Based on the International Dictionary of 1890 and 1900. Now completely revised in all Departments, including also a Gazetteer and other Appendices. Edited by Dr. W. T. Harris and F. S. Allen. Pp. lxxx+2620. (London: G. Bell and Sons, Ltd.; Springfield, Mass, U.S.A.: G. and C. Merriam Company, 1911.) Price *2l. 13s. 6d.* net.

THE origin of "Webster" dates from a notable period in the history of works of reference, the second half of the eighteenth century. Noah Webster, a teacher in the United States, entered upon his earliest work of compilation about the same time that "a society of gentlemen in Scotland" were producing the first edition of the *Encyclopaedia Britannica* in Edinburgh. His spelling book appeared in 1783; it doubtless contained the germ of his larger idea, though this was not developed for many years—the first edition of his dictionary only appeared in 1828. Apart from re-issues and supplements (and also, to judge from a warning in the prospectus, pirated editions), there have been two great revisions of the original work before the present one, namely, those of 1864 and 1890. Both in the method of presenting facts and in mechanical construction the "new" revision introduces changes so great as to justify the use of the epithet in every sense, and some of these changes are of much importance and interest to all who have been led by frequent use to formulate views on the right arrangement of works of reference.

In the first place, "Webster" is an "encyclopædic" dictionary, and in the present edition that quality has been not only sustained but brought into greater prominence. At one period in the history of the making of works of reference, strong criticism was directed against the encyclopædic type of dictionary, and on obvious grounds. It was held to be the function of a dictionary exclusively to state and account for, historically and philologically, the origin and meaning of each word, to attempt no disquisition as to its connotation, and to avoid any articulated arrangement of historical, scientific, or other information dependent upon any word as a "heading." This latter function was left to the encyclopædia exclusively. Proper names and place-names were ruled out on the same grounds. On the other hand, the encyclopædia did not trench upon the philological functions of the dictionary, nor even, to any

great extent, upon its explanatory function. But his doctrine gave a secondary place to the consideration of practical utility to the "ordinary reader," and (to put the case on no higher ground) ignored the dependence of the work of reference upon the ordinary reader for any commercial success. After all, commercial success connotes wide utility. The encyclopædic method in a dictionary offers the reader something more than the bare solution of his ignorance of the meaning of any word; it may offer him connotation (in limited doses) as well as denotation; it may assist him, as "Webster" does, by appropriate pictorial illustration.

The encyclopædic method ought not, on one hand, to be used to the exclusion of the philological and other "purer" functions of the dictionary. Nor does the new "Webster" appear to transgress this provision. On the other hand, it is obvious that encyclopædic information must be strictly limited by considerations of space, and this makes exceedingly difficult the judgment of how far it should be included at all. Therefore the following instances (by no means isolated) taken to suggest that the present editors have carried the encyclopædic principle too far, are offered with due diffidence. Under the heading "Geography," after the general definition, there follow the main divisions of the science—mathematical, physical, &c., with their scope explained—very properly. Under "Geology" the same arrangement is given, and the various branches—cosmical, stratigraphical, and the like—are referred to. Then follows:—

"Geology is of comparatively recent development. Its basis as a true science may be said to have been laid by James Hutton (1726–97). It was advanced by the investigations of William Smith (1769–1839), and notably by the teachings of Sir Charles Lyell (1797–1875)."

And so the notice ends. It is submitted that this information, thought it might have formed the introduction for a brief treatise, is, by itself, practically valueless. Take, again, the homely instance (picked at hazard) of the notice on "Football," which defines the difference between the various codes of the game so far as to indicate the allowance or exclusion of the use of the hands, but gives no hint of difference in methods of scoring, or in the numbers of players constituting sides. This is surely a partial, and therefore wrong, application of the encyclopædic method.

Every allowance ought to be made to the editors of a general work of reference in their endeavours to save space. It is therefore possible to condone the method, theoretically indefensible, by which each page of the new dictionary is made up in two parts. In the upper and larger, all words of more common use (within a very wide range) are given in triple-column arrangement. In the lower, obsolete and local words, equivalents, alternatives, uncommon compounds, and the like, calling for only slight reference, are given in an arrangement of six columns of painfully small type. An excellent feature is the printing of an easy reference to the signs used to indicate pronunciation, at the foot of every page. In planning these signs, such eccentricities as inverted letters have been happily avoided.

The illustrations do not reach the mechanical standard of other departments of the book. The coloured plates at the beginning, showing arms and flags of various nations, are indifferent, both in drawing and (at any rate in the impression before us) in colour-register, while many of the cuts illustrating the text are of somewhat archaic cast. A large selection of the latter are repeated at the end of the volume under a series of general headings, such as agriculture, anatomy, antiquities, and the like. The utility of this is not obvious; the classification reveals a certain degree of partiality, and the cuts, crowded together *en masse*, look frankly ugly.

The encyclopædic method has been held to justify, and with reason, the inclusion of a gazetteer and a biographical dictionary among the appendices. The names in these appear to have been methodically chosen. As this feature has been retained from the former issue, we do not entirely follow the editorial judgment in including scriptural, classic, and other proper names, characters of fiction, and the like, in the body of the dictionary. Such arrangement may tend to confusion on the part of the user of the book. On the other hand, he will be the more ready to excuse any difficulty in this direction in consideration of the ease with which any desired letter or section of the work may be found, for the makers have retained the familiar and excellent system of indicating sections by marked indentations in the margin of the pages, so that the closed volume may be opened at any desired place. Finally, it may be said that though the additions to the matter of the work as a whole are so numerous as to have more than doubled the number of entries in the previous edition, and to have added several hundred pages, the bulk of the volume is not seriously increased. Such criticisms as have been offered above are recognised to be mostly upon debatable ground, and it is freely admitted that the new edition does nothing to mar, and much to add to, the established reputation of "Webster."

O. J. R. H.

GLAUCOMA AND ITS CAUSE.

Glaucoma. By Dr. Thomas Henderson. Pp. xv+222. (London: Edward Arnold, 1910.) Price 10*s.* 6*d.* net.

GLAUCOMA is that condition of the eyeball in which the intraocular tension, normally greater than the superincumbent atmospheric pressure by about 20–25 mm. Hg., is pathologically still further increased so as to produce various deleterious results. It has hitherto been generally held that variations in the intraocular pressure are produced by changes in the amount of the fluid contents of the globe; that alterations in the quantity of blood may be considered negligible in this respect; and that such variations as occur affect the lymph of the eye. The lymph is thought to be secreted by the ciliary processes, and to be excreted through the so-called "filtration" angle of the anterior chamber into the venous plexus which goes by the name of the canal of Schlemm. On

this theory the intraocular tension will vary with the relationship of secretion to excretion of lymph. It is clearly a postulate of the theory that some alteration in the volume of the globe occurs under differing internal pressures, though the necessary amount may be so slight as almost to escape the ordinary crude methods of experimental analysis.

Dr. Henderson propounds a theory which is merely the application of the Monro-Kellie doctrine of intracranial pressure to the eye. This theory of intracranial pressure has been proved substantially true by the researches of Mr. Leonard Hill, and Dr. Henderson, postulating the constancy of volume of the eyeball under all pressures, physiological and pathological, embarks upon a bold attempt to make all the arguments fit in the case of the eye. He holds that in the normal eye the total volume is constant, the circulatory system is elastic, and that diffusion takes place between the contained fluids and the return (venous) circulation. Hence the intraocular pressure is equal to the venous pressure of the elastic system. In glaucoma the total volume is fixed, and there is an absence of diffusion between the contained fluids and the return circulation. Hence the fluid and incompressible contents act as a rigid volume, converting the elastic circulatory system into a rigid one. The outflow pressure of a rigid system is always higher than that of a similar elastic system of tubes. Therefore the intraocular pressure is raised, as the lowest circulatory pressure is that of a rigid, not an elastic system. The starting point of the process in glaucoma is held to be sclerosis of the cribriform or pectinate ligament, whereby the diffusion of the aqueous into Schlemm's canal is hindered. The explanation of the success of iridectomy as a cure for the disease is founded upon the fact that wounds of the healthy iris stroma do not cicatrise in the ordinary manner of connective tissues. The aqueous is thus brought into more intimate contact with the iris veins, and is enabled to drain away.

It will be realised from this brief account that the theory is revolutionary in its relation to certain hitherto accepted facts. In some such instances the author has audaciously thrown over the facts. The most striking example of this procedure concerns the anatomy of the ciliary circulation. No one has previously questioned Leber's brilliant researches on the circulation of the eye. Dr. Henderson, from an exhaustive examination of serial sections, asserts that the circulus arteriosus iridis major is not an artery but a vein. Adopting the teleological argument that there is no rhyme or reason for such an abundant arterial supply to so insignificant a structure as the iris, it is an easy step to transform arteries into veins for the benefit of the theory. We do not consider that the examination of serial sections can possibly prove the point conclusively, unless the blood-vessels have been previously injected, as was done in Leber's researches. It may be hoped that Dr. Henderson or others will adopt this more conclusive test.

Dr. Henderson's fundamental postulate, that of the constancy of volume of the eyeball under physiological and pathological pressures, cannot be accepted without reserve. The walls of the eye, though rigid, cannot be regarded as rigid in the same sense as the walls of the cranium. There is experimental evidence to the contrary, notably that afforded by the researches of Koster Gzn. Further, there is positive evidence of vasomotor changes in the intraocular blood-vessels, a fact which militates against the theory.

Moreover, if the intraocular pressure is purely a question of transmitted hydrostatic pressure in the sense of the term as used by Dr. Henderson, why does the pressure fall slowly and gradually when the eyeball is excised? This and other questions will have to be answered satisfactorily before the theory can be adopted. There is no doubt, however, that the author has elaborated an important element of the problem. His work should be read by all physiologists and ophthalmologists, and cannot but prove to be stimulating to thought, and, it may be hoped, to further experimental research.

EXPERIMENTAL THERAPEUTICS.

Einführung in die experimentelle Therapie. By Prof. M. Jacoby. Pp. vii+180. (Berlin: J. Springer, 1910.) Price 5 marks.

UNTIL the middle of last century therapeutics was a purely clinical study, the physician treating his patients on purely empirical grounds and without any clearly conceived idea of how his measures affected the course of the disease. About fifty years ago the experimental study of the action of drugs was taken up by a number of investigators, and the school of experimental pharmacology succeeded to the ancient study of materia medica. The benefits accruing to medicine from this school are recognised by all who have followed the course of therapeutics in the last half-century; but its members in some degree have stood aloof from the great movement which, beginning with the discovery of pathogenic organisms, has progressed to the discovery of their antidotes in the antitoxins, and to the treatment of disease by these last. The workers on therapeutics who have approached the subject from the bacteriological laboratory have accordingly assumed a new and distinct title for it—experimental therapeutics—and show a tendency to broaden its borders to include such work as that which has culminated in Ehrlich's discovery of the new antisyphilitic specific. Yet the methods followed by Ehrlich are exactly similar in essentials to those of Schmiedeberg or von Mering in their researches on hypnotics; and the fact that the former was seeking a remedy to act on the treponema in the tissues, and the others for a remedy for the over-excited nerve cell, does not seem to justify their subjects being classed under different headings.

The book before us seeks to give a bird's-eye view of the position of the subjects in therapeutics which have recently been investigated experimentally. Beginning with some examples of pharmacological antagonism, the author leads us through the development of the therapeutics of the internal secretions (*Substitutionstherapie*) to the experimental investigations on antiparisiticides; under this he groups the treatment with vaccines, antitoxins, and Ehrlich's

new arsenic compounds. Short chapters are devoted to the therapeutics of tumours, inflammation, blood-diseases, gout, fever, and disturbances of the circulation and digestion so far as these have been determined by experimental methods. It is, of course, impossible to treat this extensive programme exhaustively in 174 pages, and the author seems rather to have aimed at giving a general idea of what is being done to advance therapeutics experimentally with the object of arousing the interest of the students and younger practitioners of medicine in the subject. The book seems well fitted to attain this object, for it is written in an easy style, and deals with some of the most interesting topics in medicine at the present time. On the other hand, the chapters are very unequally written. In some instances pages are devoted to detailed description of surgical methods (pp. 34–36) or of individual experiments, which seem out of place in an introductory handbook, while other subjects are treated too briefly for anyone to follow except the expert; and there is very little attempt made to differentiate the fundamental experiment from the less important or less generally accepted result.

The author tends too often to leave the solid ground for speculations which are often based on experiments which, to say the least, have not yet received general assent. In a book primarily designed for German medical students, perhaps it is right to direct their attention chiefly to authors of their own nationality whose works they can read, but we cannot help thinking that some of the chapters would have been improved by wider reading. For example, the chapter on vaccines might have been rendered more intelligible and also more up-to-date.

The book is not free from serious errors; for example, where (p. 11) it is stated that Hunt found alcohol protects mice against the nitriles; and the antidotal effect of sodium sulphate in barium poisoning is surely due to the barium being precipitated, and not to the restoration of the sodium, as the author supposes (p. 13).

PROJECTIVE GEOMETRY.

Projective Geometry. By Prof. O. Veblen and Prof. J. W. Young. Vol. i. Pp. x+342. (Boston and London: Ginn and Co., 1910.) Price 15s. net.

In the first page of their introduction the authors say:

"The starting-point of any strictly logical treatment of geometry must be a set of undefined elements and relations, and a set of unproved propositions involving them; and from these all other propositions (theorems) are to be derived by the methods of formal logic."

Here, in a nutshell, is the modern mathematician's creed; and it is significant that it should thus appear in a treatise on projective geometry, which at first sight would seem to be one of the most intuitive of the branches of mathematics.

In accordance with the above dictum, the authors give a brief discussion of the axioms of geometry so far as they are required for the purposes of this volume, rightly, we think, deferring the more complete theory of order and continuity to a later stage. Enough, however, is done to make the reader aware of the numerous tacit, and often complex, assumptions made in the ordinary treatment of the subject. For instance, we have an explicit statement of the fundamental postulate:

"If A, B, C are points not all in a line, and D, E are distinct points such that (B, C, D), (C, E, A) are respectively collinear, then there is a point F such that (A, B, F) and (D, E, F) are respectively collinear."

With the help of this and a few other assumptions, a plane is defined in such a way that it can be *proved* that if A, B are any two points in a plane, every point of the line AB is in the plane. No one can fail to see that this is an improvement on the Euclidean definition of a plane, which is a question-begging assumption, based no doubt on the practical tests applied by masons and carpenters.

After this the reader is introduced to the fundamental operations of projection and section, and to the principle of duality. The latter is very properly stated, at the outset, with reference to three-dimensional space: that is, point and plane are correlative terms, not point and line. It is easy enough to deduce the special laws of duality for two-dimensional fields; and the more general form of statement at once brings home to the student the fact that, as a rule, the propositions of projective geometry arrange themselves in sets of four, only one of which need be formally proved. For instance, Pascal's theorem for a conic in a plane leads at once to Brianchon's theorem, and two corresponding theorems for a quadric cone.

Even yet it may be asserted that von Staudt is the great master of projective geometry, much as Gauss is the incomparable arithmetician. It is one of the great merits of this work that the influence of von Staudt's work is so apparent in it. For instance, involution is treated at a comparatively early stage; and this is important for several reasons. In the first place, it simplifies the proofs of many fundamental properties of conics; in the second, it shows the existence of a polar system, in a plane or in space, apart from the assumption of a quadric curve or surface defining it. Ultimately, of course, the best definition of a conic or quadric surface is that it is the locus of self-corresponding points in a polar system. This, with Staudt's theory of imaginary (or complex) elements, permits of the inclusion of "imaginary" conics and quadrics as actually existing things. It is to be hoped that the second volume will contain a sufficient account of Staudt's beautiful theory, which, as a rule, seems to be very imperfectly apprehended. As he unfolds it in the supplements to his "Geometrie der Lage," it is purely geometrical, though no doubt he was led to it by analysis—at least, this seems the most probable assumption.

Among the interesting points of the present volume there is a brief account of Staudt's theory of "throws" (*Würfe*), and his constructions for addition and multiplication. In the latter there is a slight modification, arising from a change in the order of deduction. What is here shown is that if we take any three points

on a line and provisionally label them $P(o)$, $P(1)$, (∞), and if $P(x)$, $P(y)$ are provisional labels of any other two points, then there are projective constructions defining $P(x+y)$ and $P(xy)$, such that the laws for adding and multiplying labels obey the ordinary laws of algebra, *e.g.* $P(x+y)=P(y+x)$, including the limiting cases when x or y, or both, have one of the special values 0, 1, ∞. Hence it follows that from the base points P (0, 1, ∞) we can construct a *rational scale* of points $P(r)$, where r is any rational, positive or negative number. It may be added that these are the only points on the line which can be reached from the base-points by projective constructions, and it would be a good exercise for the student to prove what is not absolutely demonstrated in the book, that this deduction is free from ambiguity; for instance, suppose $P(x)$, $P(y)$, $P(x+y)$ have each been deduced from the base-points by a chain of projective construction, it is required to prove that *the same point*, $P(x+y)$, is derivable from $P(x)$ and $P(y)$ by the single operation of addition.

The net result of these considerations may be put (among other ways) in the following form. Suppose we have a tetrahedral frame of lines with a point given on each line distinct from the two vertices of the tetrahedron which it contains. Then on each of the six lines we can construct a rational scale, and hence, by projective constructions alone, arrive at all points which can be defined by four rational homogeneous coordinates. This rational projective space is not continuous: to fill up the lacuna, it will be necessary to assume the existence of one linear continuum of points, and apparently this will be also sufficient.

Staudt, on the other hand, gives his constructions as the definitions of the addition and multiplication of throws; and because the laws of algebra are satisfied, he deduces the possibility of assigning numerical values to throws. On the whole, Staudt's procedure seems the more scientific, but it is not a matter of much importance.

A propos of involutions, attention may be directed to the proposition on p. 223: "Any projectivity in a one-dimensional form may be obtained as the product of two involutions." This is very interesting, because it shows that although involution is, in the first instance, a derivative idea (as a special case of projective correspondence) it may ultimately be regarded as elementary.

To indicate how far this volume proceeds, it will be sufficient to say that chapter x. deals with pairs and pencils of conics in a plane, and gives the typical algebraic forms according to the elementary divisors of the discriminant; while the next, and final, chapter is on families of lines, and treats briefly of ruled quadrics, line coordinates, and linear congruences and complexes. It might, by the way, interest applied mathematicians to point out that if we suppose a unit force acting along a given line, the six homogeneous coordinates of the line may be taken to be proportional to the moments of the force about the edges of the tetrahedron of reference.

G. B. M.

THE NEW PSYCHOLOGY.

Manual of Mental and Physical Tests: a Book of Directions compiled with special Reference to the Experimental Study of School Children in the Laboratory or Class-room. By Prof. G. M. Whipple. Pp. xix+534. (Baltimore, U.S.A.: Warwick and York, inc., 1910.)

IS psychology to rank among the exact sciences? This is the question which is at once raised when we look into Prof. Whipple's volume. We are reminded of Kant's famous pronouncement that psychology never could be a science, because it was impossible either to apply mathematics to its problems or to perform experiments upon the minds of others. Kant's dictum is a classical instance of the danger of prophesying the impossible. In the book before us the mathematical treatment of mental measurements is discussed in the third chapter, and the rest of the volume is made up of more or less happily devised experiments upon the minds and bodies of other people.

Yet nobody knows better than the author himself how relatively slight actual accomplishment has been. The contrast between the position of the psychologist and that of the doctor, for example, is very great. An insurance company will decide quite serious financial questions on the report of a medical man whose tests give sufficiently good *average* results for their purpose. But the psychologist has not yet achieved a position of such confidence. He deals with far subtler problems, and it is no fault of his that we have not yet begun to consult him on the future of our children. He frankly confesses that he is not ready to render such positive service; and whilst on one hand we may fairly congratulate ourselves on the fact that a serious attempt is being made to arrive at a better understanding of mental phenomena, it would, on the other hand, in Dr. Whipple's words, be wrong to speak

> "as if a science of mental tests had already been achieved. . . . To make such an assertion is surely misleading, for . . . there is, at the present time, scarcely a single mental list that can be applied unequivocally as a pyschical measuring-rod."

There is no general agreement about procedure, and in many cases psychologists do not know exactly what it is they are measuring, such is the "astounding complexity, variety, and delicacy of form of our psychical nature."

It would, nevertheless, ill become professional students of the older sciences to speak in contemptuous terms of a younger brother who is so conscious of his own shortcomings. Psychology may have long to wait for its Newton, but in the meantime the effort to collect facts in a scientific way should surely meet with every possible encouragement. The "man in the street" has long recognised the existence of differences in the mental characteristics of his friends. He accepts them in much the same spirit as folk regarded the weather, until the meteorologist began that painstaking collection of data which is just beginning to bear scientific fruit. We have more words to describe these personal differences than we have for

the discussion of weather variations, but popular analyses are proverbially unsound, and the psychologist has in recent years attacked this problem of individual differences with vigour, ingenuity, and insight.

It is as presenting a survey of work in this direction that Prof. Whipple's book is to be regarded. Hitherto nothing of the kind has been available, and the author has rendered a capital service to English workers in this field by compiling from widely extended sources such mental tests as have been used with more or less success in the study of children. The tests are arranged in the order of the simplicity of the psychical processes involved. Beginning with those which concern physical and motor capacity, they pass through those which measure the various forms of sensory acuity, to others which deal with attention, memory, suggestibility, and close with the Binet-Simon tests of intellectual development. Each test is accompanied by a critical survey of work already done in regard to it, and an exhaustive bibliography. As a mere index to the literature of this branch of psychology, the book is of the greatest value. J. A. Green.

CULTIVATION OF THE LAND.

To Work a Grass Holding at a Living Profit, and the Cheap Cottage Problem. By H. B. M. Buchanan. Pp. vi+102. (London: Constable and Co., Ltd., 1910.) Price 1s. net.

Few movements of recent years have attracted greater interest than the migration from town to country that now plays so large a part in the life of the village community. Not only does the well-to-do man live further out into the country, but the humbler town-dweller is being enticed out; and the agricultural labourer, instead of drifting off unheeded to the town, finds all sorts of inducements held out to him to remain where he is. Small holdings are one of the most important developments of this movement, and they are encouraged with the twofold object of getting more produce out of the land and of bringing up the next generation in the country rather than in the unhealthier conditions of the town. It is arguable that the small holding is, *per se*, uneconomical, since the small holder cannot have the intelligence of the good farmer, or he would long ago have become a large holder; but there can be no difference of opinion as to the desirability of raising the next generation in the country. This social aspect of the question has to be kept in view in dealing with the rather bulky literature that has grown up on the subject.

Mr. Buchanan has taken an honourable part in fostering the new movement. He has studied small holdings from within, having made some on his own estate and carefully watched their development. Two classes of small holders he considers are likely to succeed: experienced people who supplement the profits of the holding by outside employment; and colonies working on cooperative lines directed by skilled supervision. The basis of their work must be the cultivation of the land; they are not likely to succeed in raising poultry, geese, cows, &c., on purchased food, however profitable the expert may find the business. And the weak link in all our cultivation is, in Mr. Buchanan's view, the management of our grass land. To this problem, therefore, he devotes a considerable amount of attention.

Grass presents a more difficult set of problems than any other crop. It is left down permanently; seeds of all kinds blow on to the ground, and may, if they can, germinate and grow, and finally oust some of the grass previously there. There is, in fact, a constant competition for existence among the various plants, and, in general, the poorer the soil, the larger the number of plants present. Artificial manuring, mowing, grazing, and grazing supplemented by concentrated foodstuffs, all modify the conditions obtaining, and favour some species that develop to the exclusion of others. The farmer's problem is to adopt those methods of treatment that shall in the shortest time and at the least cost enable the species he wants to crowd out those he does not want. In a certain empirical way, methods are known that will more or less do this, and Mr. Buchanan sets them out clearly and concisely.

The cheap cottage problem is intimately bound up with the small holding movement. The very large landowner may be prepared to put up cottages and let them at a rent that brings in little or no interest on the outlay, but Mr. Buchanan does not think these "charity cottages," as he calls them, will solve the problem. He gives plans and specifications of cottages at 500*l.* the pair that are suitable and comfortable, but as the rent has to be 4*s.* 6*d.* a week to make the outlay profitable, he arranges that a garden and pigsty can be included, the profits of which shall pay the rent. Suitable hints are given to the cultivator, and also to the owner of the estate.

The book will be found very interesting and suggestive not only to those concerned in small holdings, but also to the cultivator and to those engaged in agricultural education work E. J. R.

NEW BOOKS ON CHEMISTRY.

(1) *Introduction to Practical Organic Chemistry, including Qualitative and Quantitative Analysis and Preparations.* By Dr. A. M. Kellas. Pp. viii+204. (London: H. Frowde and Hodder and Stoughton, 1910.) Price 3*s.* 6*d.* net.

(2) *New Reduction Methods in Volumetric Analysis.* A Monograph. By Prof. E. Knecht and Eva Hibbert. Pp. x+108. (London: Longmans, Green, and Co., 1910.) Price 3*s.* net.

(3) *Introduction to General Chemistry.* By Prof. J. T. Stoddard. Pp. xviii+432. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* net.

(1) The "Introduction to Practical Organic Chemistry" is divided into six sections. The first section deals with qualitative tests, the second with general laboratory operations; the third with preparations, the fourth and fifth with the analysis of specific compounds, and the sixth with ultimate organic analysis and molecular weight determinations.

Though the book contains very little that is original either in matter or arrangement (unless in its special adaptation to the syllabuses of certain examining bodies), there is, on the other hand, nothing which calls for adverse criticism. The laboratory operations are such as have appeared in half a dozen books on the subject. They are clearly and fully described and illustrated. There is also a useful appendix containing details of practical work presented for the preliminary science examination, part ii., of London University. We should be very sorry to follow the author in advising students wishing to carry the subject further to make an extended study of Lassar-Cohn's "Arbeitsmethoden" or Meyer's "Konstitutionsermittelung," both of them ponderous and useful, but incomparably dull and formidable, books of reference. Apart from this the book may be safely recommended to all students of practical organic chemistry.

(2) Dr. Knecht has collected in the form of a small monograph his various papers on the use of titanous chloride as a volumetric reagent. His method is so well known among analysts, and especially colour chemists, as to require no description, and its value has been fully recognised. The present volume should serve to extend its use by bringing it to the notice of a larger public, and by emphasising its remarkably wide application. Titanous salts, it may be added, are readily procurable, so that there is no obstacle in the way of their employment.

(3) "C'est le premier pas qui coute" is probably truer of text-books of chemistry than of other sciences. It is because authors will assume that chemistry is an exact science and that its principles are capable of precise definition that the opening chapters are frequently so unsatisfactory. To begin with definitions and generalisations is to court contradictions and inconsistencies at every turn. Here we have a volume by an obviously thoughtful and careful writer who attempts to define chemical and physical change. "These [physical] properties are always the same in all specimens of the same substance, whatever its source, when they are examined under the same condition," yet a few paragraphs further on we are told that the same metal may occur in a bright metallic or dull pulverulent form. Again, whilst cautiously stating that every *definite* chemical compound always contains the same elements in the proportion by weight, he says nothing about *indefinite* compounds, and adds rather recklessly that "with this constancy of composition goes a similar constancy in all of the properties which characterise the compound."

When the author has safely extricated himself from the rocks and shoals of his introductory chapters, he gets into smooth water, and the remainder of the book is plain sailing. We presume that "the first year's course" mentioned in the preface has reference to the college student; for it is certainly not a book for a beginner. The absence of all diagrams and experimental details and the use of technical terms without explanation would soon lead him into a labyrinth of difficulties.

J. B. C.

OUR BOOK SHELF.

British Ferns and their Varieties. By C. T. Druery. Pp. xi+458. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7s. 6d. net.

THE author of this book, who is well known as an enthusiast in the study and cultivation of British ferns, has succeeded in producing a work very useful to all fern-lovers. Hitherto it has been a matter of great difficulty for anyone to discover what name has been applied to a given form of any British fern, unless he has had access to some standard collection for comparison. This difficulty will now be greatly reduced by reference to the illustrations in this book, which consist of 40 coloured plates, 96 nature prints, and 319 others.

The first sixty pages are devoted to general considerations, such as the life-history of ferns, culture (including hybridisation), types of variation, and fern foes. The attempt to write these introductory chapters in popular language has, as is usual in such cases, resulted in some words being used in a sense differing from that in which they are applied in scientific works. For instance, on p. 15 the oosphere is referred to as "the incipient seed," and the antherozoids are stated to be "truly vegetative"; and on p. 27 the young plants are by preference termed "seedlings."

The remainder of the book contains detailed accounts of the British species, with short notes on their varieties and forms. The nomenclature usually adopted in British books has been retained on the ground that this work is intended "rather for the practical amateur than for the scientific botanist"; it is to be regretted, however, that synonyms are almost entirely omitted, even in the case of such a familiar one as *Nephrodium filix-mas.* The mixture of Latin and English names printed in the same type leaves one in doubt as to whether the final word forms part of the plant-name or is that of its describer or raiser, *e.g.* "*Pteris aquilina crispa cristata Druery*" (p. 221); in the case of *Polystichum pulcherrimum* (p. 211), these names are said to refer to the finder.

The wonderful variation in our native ferns is strikingly brought out in this book, which should stimulate many to become students of this very interesting group of plants, and to assist in solving the problems connected with variation.

C. H. W.

Motor Car Hill-Climbing Chart. To Show the Speed at which a given Motor Car can Climb any given Hill—to Show also the Gear upon which it can do so—and the Engine Speed in Revolutions per Minute. (London: Edward Stanford, n.d.) Price 1s. 6d. net.

THE "Motor Car Hill-Climbing Chart" consists of a card $5\frac{1}{2}$ by $3\frac{1}{2}$ inches, on the face of which there is a sliding card. The sliding card has a square hole in it covered by a transparent sheet. On this is drawn a brown curve representing the resistance due to average road and wind resistances at different speeds. Through the window three other curves, the forms of which have been determined by experiment, may be seen. These are of different colours, and are adapted to suit one each of the three gears. The sliding card can be set by means of a scale to a position corresponding to any gradient up or down. Then the intersection of the brown curve with one or other of the other curves shows which gear should be used, what speed the car should go, and the r.p.m. of the engine when the car is in good order. If the curves have been produced by experiment with the particular car, no doubt useful results will be obtained, and that most conveniently, but until all cars are alike it is difficult to see what use it will be on somebody else's car.

The Gyroscope: An Experimental Study. From Spinning-Top to Mono-Rail. By V. E. Johnson. Pp. 52. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1911.) Price 1s. 6d. net.

THIS is an admirable little book suitable from every point of view as a present for a boy with a mechanical turn of mind. As the extended title indicates, the properties of the gyroscope are illustrated by a series of experiments, always with a view to its application to a mono rail car. The reader is expected to be able to drill holes in metal and tap threads in them and perform simple constructional operations. He is thus encouraged to prepare his own apparatus and make each experiment as he goes along.

The originality of some of the experiments and the conclusions to be drawn from them, the home-made gyroscope, with the flywheel of a sewing machine as centre feature, and the general scheme of the book are all excellent, and any boy who works through the examples will find himself imperceptibly acquiring the gyroscopic sense, and he will greatly enjoy the process. One of the later devices illustrated is an electrically-driven monorail and gyrostat, for further details of which the reader is referred to the number of *The Model Engineer* in which it was first described. No doubt this is the apparatus that was shown at work at the last exhibition organised by *The Model Engineer.* C. V. B.

Simple Lessons in Nature Study. By J. O'Neill. Pp. 122. (London: Blackie and Son, Ltd., n.d.) Price 1s. net.

THIS book comprises about twenty-five lessons on plant characters and ten referring to animals; buds, the work of leaves, the dandelion, birds, the hedgehog, talks on tadpoles, are a few of the subjects discussed. It has been prepared for the use of teachers; as such it has no obvious merit, because it cannot be said to present simple facts and natural inferences in any new light, nor does it penetrate sufficiently deeply into the subject to impart the knowledge required for teaching.

Aphorisms and Reflections from the Works of T. H. Huxley. Selected by Henrietta A. Huxley. Pp. 86. (London: Watts and Co., 1911.) Price 6d.

MESSRS. WATTS AND CO. have issued these aphorisms and reflections of Huxley for the Rationalist Press Association, Ltd., by permission of Messrs. Macmillan and Co., Ltd. The price at which the book is now obtainable will, it is to be hoped, make Huxley's clear thinking and lucid expression known to a new circle of readers and send many of them to the complete works from which the apothegms are selected.

The Flight of Birds. By Giovanni A. Borelli. Pp. x+40. (London: For the Aëronautical Society of Great Britain by King, Sell, and Olding, Ltd., 1911.) Price 1s. net.

WE have here a translation of the section called "De Volatu" in the first volume of Borelli's "De Motu Animalium," first published in Rome in 1680–81. This is the first time this part of the seventeenth-century classic has been translated into English. The booklet will make an appeal to all who are interested in the conquest of the air.

Life Histories of Familiar Plants. By John J. Ward. Pp. xx+204. (London: Cassell & Co., Ltd., 1911.) Price 3s. 6d.

THIS popular edition of a book which appeared in 1908 should prove of service to teachers of nature-study and field botany. The first edition was reviewed in these columns on May 20, 1909 (vol. lxxx., p. 344), and the present issue remains unchanged.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Fox and the Fleas.

THE belief that the fox rids himself of fleas by the device to which Prof. Hughes has directed attention in NATURE is a long-established one. This is shown by the following passage from Allan Ramsay's "Gentle Shepherd," which appeared in the year 1725:—

"As fast as flaes skip to the tate o' woo,
Whilk slee tod lowrie hauds without his mow,
When he to drown them and his hips to cool,
In summer days slides backwards in a pool."

The language is the variety of English which prevailed, and of course still prevails, in North Britain. "Tate o' woo" means tuft of wool, "slee tod lowrie" means the sly fox, and "hauds without his mow," holds outside his mouth. A. N. MELDRUM.

Hamilton, N.B., April 10.

REFERRING to the letter of Prof. McKenny Hughes on the fox and the fleas, in NATURE of March 23, may I be allowed to say that I heard exactly the same story, several times over, in my youth, which means about fifty years ago? I must confess that I thought it had originated somewhere in Gascony, the home of Cyrano of Bergerac. It seems now to turn out to be true. If really authenticated, as Mr. T. Day appears to suppose it, it would be worth while to make its exact authentication known, as it may be looked upon as a most prominent proof of reasoning on the part of an animal.

Paris, March 24. T. S. GREY.

MANY years ago a few friends were chatting in Kirkby Lonsdale Vicarage, and one of us remarked that almost everybody had within his own knowledge some story that he could not expect his friends to believe. The vicar (Henry Ware, afterwards Bishop of Barrow) told us his story. He was coming out of the vicarage with Archdeacon Evans and the parish clerk, when they saw in the lime avenue in front of them a chaffinch fluttering up and down with the tip of its wing attached to one of the long pendulous twigs of a lime tree. The clerk got steps and a hook or something by which he pulled it down, and they found that the bird's wing was stuck, as they thought, by the honey dew to the leaf, while the play of the twig never let it get sufficient lateral pull to disengage it.

DE ANIMAL. SYLVES.

De dolofo ingenio Vulpium.

My story was that, when I was a boy, walking home along the banks of the Bawddwr, which was then frozen over, I saw a trout through the clear ice and took a shot at it with a stone. The stone made a small hole in the ice, through which the trout jumped out. I thought that the pressure on the ice due to the impact caused an uprush of water, which caught the trout as he darted away and carried him out head first.

It may not have been altogether the honey dew that stuck the bird's wing to the leaf, and the mechanics of my trout's leap may be better explained, but the stories are true.

So in the often repeated and much discussed story of

the sea-serpent: whether we refer what was seen to long lines of ducks now dropping out of sight in the trough of the wave, now rising in thick coil over its crest; or to water-logged baulks of timber with seaweed hanging like a mane about the ends, which were protruded or submerged with the rise and fall of the waves; or whether we accept Günther's explanation of the best authenticated case on record, which he described as a sperm whale attacked by an octopus, the dimensions of which he calculated from known examples; we admit the stories and discuss only the explanations, which in these last cited cases must differ so much.

So for Mr. Day's story of the fox and the fleas; we may examine it from several points of view. If it is a true natural history story it is extremely improbable that Mr. Day's was the first and only recorded fox who showed this instinct, or, as Samuel Butler would call it, "memory"; and, thanks to many friends, I can give more or less clear references to previous observations of the same kind. Mr. Nichols tells me that he has heard it mentioned as a story current among Celtic people—likely enough, as they are chiefly pastoral and close observers of natural phenomena. Mr. Grey in his letter, which by your courtesy I have seen, thinks he remembers it as belonging to Gascony. But the most important contribution to the discussion, so far, is a reference sent by my friend and pupil Mr. Frank Barclay, which I have verified in the university library.

Olaus Magnus, writing in 1555, says:—

"Praeterea cùm pulices habet, fasciculum mollis foeni ore accipit pilis involutum, seque paulatim posterius inchoando in aquam mergit, ac totum corpus, ut pulices aquam fugientes, ad caput ascendant. Deinde caput immergit, ut in foenum fugiant; quo facto, foenum relinquit in aqua, et mox enatat."

Besides, when he has fleas he takes in his mouth a bundle of soft hay rolled up in hair, and gradually immerses himself in the water back end first, and then his whole body, so that the fleas, trying to escape from the water, may creep up to his head. Then he draws his head under water that the fleas may be driven to take refuge in the hay, and when this has been done he lets the hay go in the water, and forthwith swims out.

The amusing figure which Olaus Magnus gives in illustration of the various cunning devices of foxes which he describes has been admirably reproduced by Mr. Edwin Wilson.

Foenum pilis involutum is not quite clear. Mr. Day does not remember anything about hay, and in Olaus Magnus's picture there is nothing like hair or wool shown; but the word is late Latin, and may be used as loosely as the modern "pile," which is either hair or the soft, fluffy nap taken off the surface of cloth. That is, however, unimportant. But I was given an interesting fact in corroboration of the probability that the fleas would readily betake themselves to wool. Miss Parsons, of Horseheath, a shrewd observer of natural phenomena and collector of folklore, told me that it was a common opinion among farm people that if poultry and poultry houses were infested by fleas the best way to get rid of them was to drive a flock of sheep among them, as every flea would take to the wool.

There is another point to be considered—I do not know that a fox is an animal much troubled by fleas. It may be that the curious procedure on the part of Mr. Day's fox was not a thing of common occurrence, but only when the animal had the misfortune to be suddenly attacked by an abnormal number; for great swarms of fleas do suddenly appear, not only on certain individuals or groups of animals, but on walls and wooden partitions. Some of your readers will remember the story of Dr. Michael Foster's dog and the fleas, which he carried in from a wall outside the house. I have myself seen the wooden frame of a hot-bed covered with them, and sometimes a hedgehog carries an enormous number.

A fox's calling takes him occasionally to hen houses, and commonly to earths frequented by hedgehogs, and he might therefore sometimes have to take strong measures to get rid of the excessive number of fleas he had carried from such places.

Mr. Day vouches for the truth of the story as I gave it in your issue of March 23, except that the hurdles and straw were put up to shelter him and his father, and not to protect sheep and lambs, for it was in July (1843).

The fox went into a deep part of the small stream that runs by Mob's Hall into the Rhee or Cam near Thistly-ground Farm, about a mile west of Guilden Morden.

T. McKENNY HUGHES.

Ravensworth, Brooklands Avenue, Cambridge.

The Radiation producing Aurora Borealis.

As is well known, Prof. Birkeland has put forward the hypothesis that aurora borealis and magnetic disturbances are due to an "electric radiation" coming from the sun. The numerous observations, partly from the regions near the auroral zone, treated by Birkeland in his work "The Norwegian Aurora Polaris Expedition, 1902–1903," as well as the theoretical work by Prof. Störmer, have shown that this hypothesis in a very satisfactory way accounts

for the characteristic properties of aurora and magnetic disturbances, as well as regards occurrence as with respect to distribution in space relative to the earth.

The phenomena of aurora and magnetic storms, however, show a great variety of forms, and further knowledge will be required until we are able to follow every single phenomenon into details. From the point of view of Birkeland's hypothesis, it will be the next step to determine more definitely the properties of those "electric rays" which in the various cases produce the aurora and magnetic storms.

From the position of the auroral zone, Birkeland has already (*Comptes rendus*, 1910) estimated the average stiffness of the rays as measured by their deviation in a magnetic field, and he found that the rays are ten times as stiff as ordinary α rays.

The question would now naturally suggest itself, Is the "electric radiation" of the type of β rays consisting of corpuscles or of the type of α rays consisting of atoms? It is my intention in this note to direct attention to certain points which may guide us regarding this question.

As is well known, the law governing the absorption of the rays by matter is very different for the two types. The α rays penetrate matter in nearly straight-lined orbits, and only a very small fraction is scattered to any appreciable amount. The velocity of the α particle gradually diminishes as the particle passes through matter, and for a certain velocity it loses its power of ionising the mole-

cules of a gas and to produce photochemical action. The number of ions produced per unit length along the path of the α particle has its maximum very near the point where it loses its ionising power. The β particles, however, are almost completely scattered in the first thin layer of matter, and inside it the radiation broadens out in all directions, and any trace of the direction of the impinging rays is soon lost.

In the aurora, according to Birkeland's theory, we are actually examining the luminosity produced when the electric radiation strikes the upper strata of the atmosphere, and from the form and structure of the luminosity we should be able to examine the way in which the solar radiation is absorbed by matter.

One of the most conspicuous forms of aurora are the draperies, of which an illustration is given in the accompanying figure. We notice the straight-lined structure. That the draperies are formed by something coming towards the earth from outside will be evident to all who have witnessed their formation. On March 27, 1910, the writer had the opportunity of examining a most brilliant aurora from the mountains of "Jotunheimen." Brilliant draperies were formed, and they could be seen actually falling down in the direction of the streamers, one bundle adding itself to another in rapid succession so as to form long spirals and bands. Now the structure of the luminosity is just as would be expected if the draperies were formed by a type of rays showing an absorption like that found for the α rays. Looking at the luminosity along the transverse streamers, we shall always notice that the intensity gradually increases downwards, but stops all of a sudden, just as it is found for the ionisation produced by an α particle along its path.

I do not mean to say that it is exactly α rays or charged helium atoms which produce draperies, but I think that the similarity in absorption strongly points to a similarity in type of radiation—in other words, that the rays producing the draperies are of atomic size and carry an electric charge.

The fact that the draperies occur mostly on the evening and night side of the earth should, according to the law of the magnetic deflection, require a negative charge of the rays; but such rays may well be possible, for, as we know, Sir J. J. Thomson has found that accompanying the positive rays in a vacuum tube there are other rays formed by atoms, but carrying a negative charge.

In view of the fact that a number of the same spectral lines are found in the corona and the aurora spectrum, which belong to the rare gases, it would be natural to suppose that these inert gases, *e.g.* argon, neon, xenon, krypton, helium, and possibly coronium, are forming the carriers of the "electric radiation" producing the draperies.

The existence of such radiation does not in any way exclude the existence of corpuscular rays; these may be the cause of the auroral "arch," which has just the diffuse appearance to be expected from the law of absorption of the β rays. Further, the magnetic disturbances may to a great extent be due to radiation of the β-ray type.

L. VEGARD.

University of Christiania, March 16.

The Velocity of Earth Movements caused by the Messina Earthquake.

I AM deeply indebted to Prof. J. Milne, F.R.S., who, in NATURE of March 23, did me the honour of directing the attention of scientific men to my memoir on the velocity of earth movements caused by the Messina earthquake. As the notice contains some remarks on my work which require a little explanation, I beg to be permitted to state my views here.

According to some seismologists, the position of the hypocentre is at the intersection of an asymptote to Schmidt's hodograph, with a vertical ordinate drawn through its apex. It seems to me, therefore, that the absence of any measurable flexure in the curves may really mean that the hypocentre of the Messina earthquake was very shallow. That is, however, a matter of opinion about which seismologists can easily be divided, and I have no desire to insist on this subject.

Prof. Milne assumes that I divided the large-wave phase of the seismograms into three parts, called L_1, L_2, L_3, being L_1 the commencement of maximum motion, L_2 the maximum movement itself, and L_3 the phase which travels the slowest. He adds that if this is to be accepted as a definite and recognisable phase in a seismogram, there seems to be no reason why we should not also accept many other phases, which may be indicated by the letters L_4, L_5, L_6, &c. The remark is of interest, but I deserve neither praise nor blame for the division of the large-wave portion of seismological registrations. Prof. Milne well knows that the division of the principal portion of a seismogram into six groups was done by Prof. Omori, analysing the registrations obtained at Tokio, and such a division is now accepted by almost all seismologists. In my memoir, L_1 indicates the commencement of the initial phase; L_2 and L_3 are respectively the commencements of the slow-period and of the quick-period phases of the principal portion of the registrations, according to Prof. Omori's division.

Instead of considering as a whole the large-wave phase, which involves some uncertainty (as often the commencement of the principal portion is assumed to be on Omori's initial phase and at other times the commencement of the same principal portion is referred to the slow-period phase), I tried to distinguish in all seismograms the first three groups of the large-wave phase, L_1, L_2, L_3. I am not dissatisfied at having done this, because I have obtained some results which I think are not without importance for physical seismology.

I conclude by expressing my warmest thanks to Prof. Milne for his notice and for the valuable article on the necessity of restoring the Messina Observatory contributed by him to NATURE of February 16.

Messina, March 30. G. B. RIZZO.

FROM THE NIGER TO THE NILE ACROSS AFRICA.[1]

DR. KARL KUMM (whom, from the indirect statements made in his book, we take to be of Swiss origin, and who now seems to be for all practical purposes an Englishman) assisted to found the Sudan United Mission in 1907–8. This mission was expressly intended to work in the Nigerian and Egyptian Sudan to counteract the Moslem advance, and Christianise the pagan tribes of negroes not as yet influenced by the Muhammadan religion. His previous acquaintance with Africa (according to the statements made in his "exordium") has been considerable. In 1899 he had visited "the southern oases of the Libyan Desert," and had travelled a considerable distance on the way to Darfur. In 1901 he travelled in Nubia. In 1904 he journeyed from Tripoli southwards into the mountainous region north of Fezzan and studied the Hausa language. In 1904–5 he led an expedition of investigation into northern Nigeria. In the two following years he visited America and South Africa to arouse interest in his mission and secure data as to the advance of Islam in the direction of the Zambezi. On his return from South Africa he visited Portuguese East Africa, Mombasa, and made a hasty journey to Uganda.

In October, 1908, he left Liverpool with seven missionaries of the newly formed Sudan United Mission to visit or to found mission stations in northern Nigeria, and establish a home for freed slaves. He further intended, if practicable, to cross Africa along the border-line between Islam and paganism.

The book under review is the result of this last journey, which extended from Forcados, at the mouth of the Niger, along the course of the Benue to the Musgu country on the Shari, thence up the Shari River to Fort Archambault, and from that point along the line of water-parting (more or less) between the Shari, the Congo, and the Nile. He emerged into some-

[1] "From Hausaland to Egypt, through the Sudan." By Dr. H. Karl W. Kumm. Pp. xiv+324. (London: Constable and Co., Ltd., 1910.) Price 16s. net.

thing like civilisation at Shambi, on the White Nile, midway between Lado and Fashoda. From Lado he descended the White Nile to Khartum, and thence journeyed home through Egypt. From the point of view of travel and endurance, it was the latest and not the least noticeable crossing of Africa; though to the thinking of the present reviewer, one of the most remarkable achievements in crossing Africa was that accomplished by Mr. Walter Savage Landor a few years ago. This last-named traveller, in ordinary clothes and an ordinary hat and boots, armed with a walking-stick, and attended by one or two faithful Somalis (as a nucleus), quietly walked the greater part of the way across Africa at its very broadest, from east to west, from Somaliland to Senegambia. Mr. Landor would seem to have been somewhat shabbily treated by the geographical societies of the world in the relatively slight recognition which followed his feat. Apparently the reason for this is the same cause as that of the somewhat unkindly reviews of Dr. Karl Kumm's book, which have recently appeared in one or two journals, namely, that the mere traversing of Africa on foot, or by any other means of progression available, counts for very little unless such a journey is accompanied by the gathering of new and important information regarding the geology, geography, zoology, botany, or anthropology of the country traversed.

FIG. 1.—A Sara-Kabba woman carrying a plate in her lips. From "From Hausaland to Egypt."

No doubt there is some excuse for this point of view. But without reopening for the moment the question of Mr. Landor, the disparagement of Dr. Kumm's book seems a little harsh. *La plus belle fille ne peut donner que ce qu'elle a.* Dr. Kumm, perhaps, is most noteworthy (from the point of view of a biologist) as a collector of butterflies and moths. He managed to bring home 250 specimens of Lepidoptera, which have been named at the British Museum, and these are illustrated in the work under review by a selection of noteworthy forms very beautifully produced in colour, apparently by photography. So far as can be gathered from the book, none of these forms is completely new to science, but not a few of them are new as objects of wonder or beauty to the average reader.

A little further information is given regarding the zoology of these southern Sudan regions. A pair of horns of the variety of the Cape buffalo, found in the Shari valley and Lake Chad regions, illustrates the local Chad race of buffalo, known to us, however, since the early part of the nineteenth century. Dr. Kumm mentions that the young buffaloes of this variety are red in the colour of their hair, but become perfectly black when full grown. From the Shari valley he brought back the portion of the skull of a giraffe, showing in the two principal ossicones the beginnings of an embranchment, a most interesting feature as evidencing the latent tendency in this group (with which, perhaps, the Pronghorn is very distantly allied) which led in Miocene times to such results as the extraordinary branched antlers of the Sivatherium. This same Shari giraffe exhibited an exceptional development of the ossicone on the nasal bones between the eyes. Instead of being a mere bump, it rises to a considerable knob with an attenuated stem. Dr. Kumm also shot a rhinoceros in the Shari valley, an interesting fact as serving with other scanty information to show that the range of the rhinoceros does extend across west Central Africa to western Nigeria. Until recently, no proof had been advanced to show that the rhinoceros (unlike the zebra) was found west of the White Nile; though there is, of course, the tradition that the Romans, in their abortive expedition to Lake Chad about the year 21 A.D., entered a region on the outskirts of the Sahara Desert which swarmed with "unicorns." Dr. Kumm also thinks that he has discovered a new species or variety of crocodile, in which the bluish-black markings on the scales (present in the Nile and Slender-nosed crocodiles) have an exaggerated development, and form regular, blackish, vertical bands round the body. But this discovery is only an assertion backed up by a sketch from memory.

FIG. 2.—Horns of Shari-Chad Giraffe. From "From Hausaland to Egypt."

In Appendix A, Dr. Kumm gives some proverbs from the Beri-beri language, but we are not told (so far as I can gather) what is the geographical location of this speech. He supplies, further, a vocabulary of Bagirmi words, which, in view of Barth's admirable study of that language, is not a striking novelty. His vocabulary of Sara is more useful, though that speech of the very heart of Africa has already been illustrated by the French. Quite new, or at any rate, very nearly so, are his vocabularies of Nilim and Korbal of the Shari region. He also gives a few words of Sango, a language of the Upper Mubangi. The photographs illustrating the book are for the

most part of only tolerable interest and appositeness; the drawings which supplement the photographs are exceedingly bad: one wonders that the publishers could have inserted such. Amongst the more interesting illustrations is that of a Sara-Kabba woman, with her lips expanded artificially into something like a duck's beak. This method of deforming the lips seems to be a very old one amongst the negro race, and to have existed in ancient times in the westernmost parts of Nigeria. From the very heart of Africa, where Dr. Kumm came across it, it extends sporadically to the region between the Albert Nyanza and the Upper Congo; then, after another long gap in distance, reappears in parts of German East Africa, and attains a notable development (described by Livingstone) in the regions between Lake Nyasa and the coast.

Dr. Kumm gives a chapter on the anthropology of the Sudan tribes, which contains some new information, and especially some interesting illustrations of the many different methods of skin mutilation on the face (cicatrisation). He writes, however, much too freely about "Bantu," ascribing to the Bantu group of African people many tribes which have absolutely nothing to do with that language family. Although the conventional "Bantu" physical type is associated mostly with peoples of the Upper Congo of the lake regions and of South Africa who happen to speak Bantu languages, it is also to be met with elsewhere in West and Central Africa amongst tribes quite outside the Bantu language field. It short, it is better to drop the use of the term for any other but linguistic classifications.

H. H. Johnston.

THE NĀGAS OF MANIPUR.[1]

THE monograph before us, descriptive of the Nāgas (included in the Tibeto-Burman group of races), is issued by the Government, Eastern Bengal, as one of the series which already includes volumes on the Khasis, Meitheis, Mikirs, and Garos. Mr. Hodson's survey extends only to the branch of the tribe settled in Manipur, numbering about 100,000 out of a total population of 162,000 in British India.

As regards social organisation, the clan, an aggregation of households, forms the permanent political unit. the tribe being only a group of clans with little or no solidarity. The only tribal bond appears in the enforcement of common taboos of food and seclusion, and in the rule that a man must not marry a woman

Photo. E. J. Mitchell.

Mao Nāgas. From "The Nāga Tribes of Manipur.

whose speech differs from his own. This is due to the inhospitable character of the land and to the ferocity of its inhabitants, facts which also affect the linguistics. As Dr. Grierson has shown, this type of monosyllabic language, possessing no literature, with a floating pronunciation, and a number of loosely used prefixes and suffixes, being necessarily subject to rapid change, emigrants settled at a comparatively short distance develop a dialect unintelligible to members of the parent village. This absence of tribal organisation adds greatly to the difficulty of bringing these wild highlanders under control.

The Nāgas combine with a fairly advanced material culture many barbaric practices. While part of their farming is on the Jhum system, that is to say, the periodical burning of patches of jungle and sowing the seed in the ashes, they also possess terraced fields

[1] "The Nāga Tribes of Manipur." By T. C. Hodson Pp. xiii+212. (London: Macmillan and Co., Ltd. 1911.) Price 8s. 6d. net.

irrigated with water brought from considerable distances along skilfully aligned channels. They demarcate their village boundaries and recognise rights of property in land. They are skilled in weaving, make fairly good pottery, extract salt from brine wells, work up imported iron into weapons and implements, and are adepts in mat and basket weaving. Still, in spite of these advances towards civilisation, they practised up to quite recent times the brutal custom of head-hunting. As connected with their funereal rites this may be piacular, propitiatory, or both. It seems reasonable to suppose that, like the Wa of Burma, they procure heads in the hope that the soul of the victim will accompany his skull, and that when hung up in the house of its possessor this will act as a guardian against the powers of evil, the skull of a stranger being preferred, because the ghost does not know its way about, and is less likely to wander. Mr. Hodson has done good service in pointing out how the custom is connected with the blood feud, with funerary rites and eschatological beliefs, and that it has a social side as a proof of fitness for initiation into the tribe. Hence it is often encouraged by women, who laugh at young men appearing at the village festivals without the decoration which marks the successful warrior.

Mr. Hodson's careful review of the tribal and village customs, particularly the institution of taboos and the use of the communal house for males, superstitions, and religious beliefs, a survey largely based on personal intercourse with the tribe, forms an important contribution to the ethnology of India.

THE PENNY: A SUGGESTION.

DEAR old penny! You have been with me all my life. You were the first present I ever had, and when I was young your potentiality was great. You would buy everything a boy required—peg-tops, jam tarts, kites, marbles, or a bun. As I grew older I recognised that your purchasing power did not keep pace with my desires. Still, you do something—you give me a paper, a box of matches, or carry me long distances on trams or buses. With two or three pennies in my pocket I feel armed against emergencies. You will dry an urchin's tears or give comfort to a beggar. You have been and still remain a friend to young and old.

But with all your virtues you have still some drawbacks. I think you are susceptible of great improvement.

The ordinary person likes you in twos or threes, but in quantity he calls you "coppers." When in this form, the young lady in the shop frequently apologises —not for you so much, as for her inability to represent you by some other coin.

Forty-eight coppers, so says the law, weigh one pound; but nobody, whatever his vocation may be, cares to carry a pound, whether it be represented by forty-eight pennies or a lump of brass in his pocket. Not only would they weigh him down, but possibly they might spoil his figure. From the legal definition you should weigh one-third of an ounce, or 145·8333 grains. The latter number frightens me; it is indefinite and without end. It means nothing for common use. To carry about a weight which cannot be used to weigh anything in particular, not even a letter, is not practical. It is silly. If our penny could be made to weigh a little bit less but remain commensurable with an ounce, even if a hole was bored through its centre to reduce its weight, which would tell you what it was by its feel, the Chancellor of the Exchequer would, by the saving in metal, certainly be possessed of wealth equal to the fees of many Baronetcies. The public would have less load to carry, and rich and poor would have in their pockets a useful standard of weight.

As I am now finding fault, let me next ask whether you measure anything in particular. In your modern form, so far as I know, there is as little respectability in your dimensions as in your weight.

A penny is one out of a number of little discs that can be economically stamped out of a sheet of bronze. We are told that a bit of metal goes through rolls, which are so wonderfully adjusted that the resultant strips or "fillets" do not vary more than 1/10,000 part of an inch in their thickness. This suggests that the authors of the penny wished it to possess an accuracy bordering on the supernatural. But the subsequent punching, pressing, and milling has apparently done much to destroy their good intentions.

When you, little penny, entered the world, you were bright and shiny, with all the lustre, and colour of burnished gold; but your guinea-like look never lasted more than a few short weeks. You quickly became the microbic-covered old brown copper. You look round, you are supposed to be round, but are you really round?

Many times per day somebody or other wishes to draw a circle, puts you on a piece of paper, and scratches a pencil round your edge. Now and then the housewife puts you on a piece of linen to mark out buttonholes or points for decoration. The results look excellent, and satisfy many purposes, but a pair of callipers show that you have more than one diameter. The least diameter of our world runs from the north pole to the south, but if the north pole of a penny is Britannia's head and the fringes of her skirts the south, this is your longest diameter. Poor old penny, your dimensions have been made opposite to those of the world in which you circulate. The world is world-shaped, and you are penny-shaped. You only possess an average diameter, which is not an inch or an inch and a quarter, neither does it appear to be related to any everyday unit of linear measure. Your dimensions, like your weight, suggest an oversight on the part of your creators. You are lopsided and measure nothing in particular.

As you exist at the present day you measure a tiny little bit more than one inch and one-fifth. Why "the tiny little bit" exists, I and my friends connected with minting cannot tell. Knock it off, and the Exchequer would increase its capital without extra taxation, and five pennies would measure exactly six inches.

But reformation should go still farther, and the diameter of a penny, if possible, be made to measure something more definite by itself. If the halfpenny, which does measure one inch, stands in the way, do not disgrace it, but reduce it to another standard.

Our poor dumb friend, not only because it neither possesses a useful weight or measure, has been compelled to take a back place in numismatic competitions, but it has had to put up with a bit of extra weight in the form of an inscription. On one side of our penny we see a statement in abbreviated Latin which tells us that the Ruling Monarch is a defender of the faith. With this the penny gives us something to think about both day and night, and to many the statement may be regarded as in keeping with its weight and measure. On the reverse, we see a brave-looking, long-limbed lady sitting on a chariot, one wheel of which appears to be elliptical. I have been quite curious about this personage, and with the help of a magnifying glass have compared her face as shown on pennies and halfpennies. As a result of my examination I conclude there are at least two types of Britannia. The aristocratic, with a Grecian nose, and the democratic, with a *nez retroussé*. Possibly

the differences may be due to pressing, punching, or to wear and tear.

Therefore you are, dear old penny, from my point of view simply a token, without definite weight, definite dimensions, and with a variable expression.

The Spanish "penny" is marked ten grammes, and it also reads 100 pieces make one kilo. The "halfpenny" weighs 5 grammes, and, like the larger coin, is largely used for purposes of weighing. These coins also have useful dimensions.

If Britannia could be induced to sit a little more forward on her shield, with this and other slight adjustments, the penny would have a definite centre of gravity, and be of use as a plumb-bob, or as a pendulum in our board schools. With properly spaced milling on its edge, pennies could be used by Boy Scouts as angle measurers or rough protractors. When drawing plans, with one penny, and another to buy a compass, he could tell the time, or without a compass and with a watch he would know his bearings. With a piece of thread, a pebble for a weight, and a penny a clinometer could be made.

Whether any of these suggestions could possibly be carried out in practice remains for the consideration of the controllers of our coinage. A penny has had an up and down time of it. It has been altered often, and why not once again. The Romans possibly were too proud to accept small change, which, when handed to them, they flicked off the counter with the back of a finger, remarking "Romanus sum." At all events Roman coins seem to have been scattered over countries where Romans once resided, and now their coins are among the most common evidences of their former occupation. Six hundred years ago, when the penny was made of silver, it would pay a wage or buy a horse. Now it is only a little brown token. If the Chancellor of the Exchequer could see how to cut off "the little bit," make "the little hole" and use a less expensive metal the penny would be reincarnated, become the admiration of the world, taxation would be relieved, and Lloyd George worshipped. But do not forget to treat other tokens as you would the penny. Make them more cheaply and increase their usefulness.

John Milne.

THE BRITISH SCIENCE GUILD.

The fifth annual meeting of the guild was held at the Mansion House on April 7, under the presidency of the Lord Mayor. There was a fairly good attendance, and the number of well-known leaders in the field of technical and scientific education was large. Sir William White presented the annual report, and referred to the progress made during the year in various directions. Of the special activities of the guild, he mentioned the work of the subcommittees upon agricultural education, the proposed museum at South Kensington for the physical and mechanical sciences, medical education, and the relation of the Imperial College of Science and Technology with the University of London. From the annual report itself we learn that committees have also been investigating the problems involved in the conservation of natural sources of energy and the coordination of charitable effort. The guild has further benefited science and the community by its successful action in regard to the site of the Solar Physics Observatory; the existence of the science section at the Japan-British Exhibition, and the inclusion of a similar section in the plans for the forthcoming Coronation Exhibition, are also in large measure due to the guild's influence.

The features of the year's progress which Sir William White emphasised were the improved attitude of the Government towards agricultural research, and the greater readiness of Government departments generally to seek the advice of highly qualified men of science. In certain instances this readiness led to the appointment of consultative committees, which were acting in an advisory capacity to several departments. At the same time, Prof. R. A. Gregory's report showed how much more was being done in other countries to promote research. The organisation of the Canadian Committee has made good progress, and its first annual report has been issued. The spread of evening classes and the movement in favour of continued education are hopeful indications of the public recognition of the value of technical instruction.

Lord Haldane thought that the technical education which was at present being given in England was underrated. In higher education, in the application of science to industry, Germany had marked features which we did not possess; but evening schools and classes connected with the universities or great technical colleges were little known in Germany. Technical teaching had developed in a very striking way in London and throughout the United Kingdom. It was not without result. The quality of British goods commanded the respect of the world. Science was present in every corner of the Sheffield factories in which engines of war—offensive and defensive—were being constructed. Our Government was a very unscientific-looking machine, but it was being substantially and rapidly improved every year. There was far more intercommunication between various Government offices than was generally supposed. He hoped to see remarkable developments before long in the domain of public health.

We cannot refrain from expressing our regret that Lord Haldane should have dwelt so strongly on the merits of our evening-class system without qualifying his praise of this system by some mention of its inevitable shortcomings. The Technical Education Committee of the guild views the matter in a different light. This committee presented a very valuable report, and we quote from the last sentences preceding the recommendations which it contains:—

> Most of the technical instruction carried on in Great Britain is evening-class work. The committee, however, are strongly of opinion that day work is of infinitely greater value than work done in the evenings, when neither instructor nor student can possibly be at their best; consequently, evening work cannot be compared for thoroughness and efficiency with such day-class work as is done in the German, and in some of our higher, technical institutes. *Until this is recognised, it is impossible for this country to expect to compete technically with other countries.* (The italics are our own.)

There are valuable contributions appended to this committee's report by Dr. H. T. Bovey, Prof. Meldola, Dr. Pohl, Prof. Gregory, and Prof. Perry. The last-named awards an overdue meed of praise to the too-belittled work of the Science and Art Department, and has a word of encouragement for workers in evening classes, but he adds a strong appeal to employers to allow apprentices to attend science classes "*during the regular working hours*" (the italics are Prof. Perry's). It is evident from these reports that the guild is doing more than interest public men and impress them with the importance of scientific method, for through its committees it is doing the spade-work essential to the conversion of aspiration into practice. It is to be regretted, however, that no mention is made of the Education (Choice of Employment) Act which was passed in November, 1910. Though this may appear to be a very modest piece of legislation, it may well prove to be the starting point of national and

local systems for fulfilling one of the great aims of the guild, viz., organising the training of the youth of the country for industries and citizenship.

We hope that Lord Haldane will add the influence of his personal prestige to the authority of the president of the British Science Guild, so that the need of developing a *higher quality* of technical education in this country may be impressed upon local administrators and the general public. No better text for a discourse upon this theme need be sought than the sentence quoted so appropriately in the annual report from one of the last public utterances of King Edward VII.:—

As time goes on, I feel more and more convinced that the prosperity, even the very safety and existence, of our country depend on the quality of the scientific and technical training of those who are to guide and control our industries.

G. F. D.

The following gentlemen were elected as vice-presidents of the Guild at the annual meeting:—the American Ambassador, Sir Thomas Barlow, K.C.V.O., F.R.S., Sir Lauder Brunton, Bart., F.R.S., Sir Ernest Shackleton, C.V.O., and Major O'Meara, R.E., C.M.G.

The membership of the Guild, including the Canadian Branch, has increased from 793 at the end of 1907 to 872 at the end of 1910; of these, 28 are life fellows, 58 fellows subscribing annually, and 425 life members. In addition to these, there are 7 members belonging to the Australian Branch, of whom 5 are life members.

The following were elected to form the executive committee for 1911–12; the names of new members are printed in italics:—*President*, Rt. Hon. Viscount Haldane, K.C., F.R.S.; *hon. treasurer*, Rt. Hon. Lord Avebury, P.C., F.R.S.; *hon. assist. treasurer*, Lady Lockyer; *vice-presidents*, *Sir Thomas Barlow, K.C.V.O., F.R.S.*, Sir David Gill, K.C.B., F.R.S.; *chairman of committees*, Sir Norman Lockyer, K.C.B., F.R.S.; *vice-chairmen of committees*, Sir Hugh Bell, Bart., Hon. Sir John Cockburn, K.C.M.G., Prof. Meldola, F.R.S., Sir William Ramsay, K.C.B., F.R.S., Mr. F. Verney; *other members*, *Mr. Wm. Phipson Beale, K.C., M.P.*, Dr. G. T. Beilby, F.R.S., Dr. Bovey, F.R.S., Sir Edward Brabrook, C.B., *Mr. Harold Cox*, *Prof. Farmer, F.R.S.*, *Sir Luke Fildes, R.A.*, Surgeon-General Sir A. Keogh, K.C.B., Prof. A. Liversidge, F.R.S., Mr. A. Mosely, C.M.G., Mr. C. Freeman Murray, Prof. J. Perry, F.R.S., Sir Boverton Redwood, Mrs. W. N. Shaw, Mr. Carmichael Thomas, Dr. A. D. Waller, F.R.S., Colonel Sir John Young, C.V.O.; *hon. secretaries*, Sir Alex. Pedler, C.I.E., F.R.S., Dr. F. Mollwo Perkin.

NOTES.

Dr. L. A. Bauer, director of the Department Terrestrial Magnetism of the Carnegie Institution of Washington, sailed from Vancouver, B.C., on March 24 on a trip of inspection of the non-magnetic yacht *Carnegie* at Colombo, Ceylon, where she is due to arrive some time in June next. *En route* Dr. Bauer will call at the magnetic observatories at Melbourne and Christchurch.

We regret to see the announcement, in *The Times*, of the death of Mr. Charles du Bois Larbalestier, a leading authority on lichens, to whom the last edition of Leighton's "Lichen Flora" was dedicated; and also of Mr. J. S. Slater, for many years principal of the Civil Engineering College, Sibpur, near Calcutta.

The following have been elected by H.H. the Prince of Monaco the members of the first council of the new Institute of Human Palæontology in Paris:—MM. Salomon Reinach, Boule, Verneau, Cartailhac, Capitan, Villeneuve, for France; Sir Ray Lankester for the British Isles; Prof. von Luschan for Germany; Prof. Hoernes for Austria-Hungary; Prof. Issel for Italy, and Prof. G. Retzius for the Scandinavian countries.

Dr. S. F. Emmons, an American geologist of distinction, died at Washington on March 28. He was born in Boston in 1841, and, after graduating at Harvard, studied at the Schools of Mines in Paris and Freiberg. He had been connected with the U.S. Geological Survey since 1867, and was a prolific author of geological publications, especially reports on explorations in the Rocky Mountains and Colorado.

Dr. D. Mawson, whose paper on the Australasian Antarctic Expedition, read before the Royal Geographical Society on Monday, appears elsewhere in this issue, announced to the society, towards the close of his address, that the Commonwealth Parliament will probably be asked by the Government to vote a sum of 20,000*l.* towards the expenses of the expedition. The council of the Royal Geographical Society has decided to contribute the sum of 500*l.* to the expedition.

Dr. J. S. Flett has been appointed to succeed Dr. J. Horne, F.R.S., as assistant in Scotland to the director of the Geological Survey. Dr. Flett is a graduate of Edinburgh University, where he was Baxter Scholar, Falconer Fellow in Geology, and a Heriot Research Fellow. He was for four years lecturer on petrology in the University, and in 1901 joined the Geological Survey. In 1903 he was appointed petrographer to the Survey. After the West Indian eruptions in 1901, he was sent out with Dr. Tempest Anderson by the Royal Society of London to report on the volcanic phenomena. He has published many scientific papers dealing principally with the volcanic and metamorphic rocks of the British Isles, and he has contributed largely to the memoirs of the Geological Survey, not only on Scotland, but also on Cornwall and Devon. For scientific research he was awarded the Neill medal by the Royal Society of Edinburgh (1902) and the Bigsby medal by the Geological Society of London (1909).

The Walker prize of the Royal College of Surgeons, founded to encourage investigation into the pathology and therapeutics of cancer, has been awarded to Dr. E. F. Bashford, general superintendent and director of the laboratory of the Imperial Cancer Research Fund of London. The value of the prize is 100*l.* The Cartwright prize, consisting of the Cartwright medal and 70*l.*, has been awarded to Mr. H. P. Pickerill, professor of dentistry and director of the dental school at the University of Otago, New Zealand, for his essay on "The Prevention of Dental Caries." The Jacksonian prize has been awarded to Mr. K. Macfarlane Walker, of St. Bartholomew's Hospital, for his essay on "Tuberculous Disease of the Urinary Bladder and Male Genital Organs."

All the necessary arrangements have now been made by the General Post Office and the postal authorities abroad for a prolonged series of long-distance tests over the new submarine telephone cable which, as already stated in these columns, has been laid between Dover and Cap Grisnez. The tests will take place between various provincial towns in England and towns in Holland, Germany, and Switzerland, and it is expected that our foreign telephone service will be very greatly extended in consequence. No public service, however, will be offered until 90 per cent. of the test calls have proved successful. When this fact has been ascertained, there is no reason why, under ordinary conditions, speech over the line should not be quite distinct. There must, however, always be the chance that gales and blizzards may cause interruptions on the land lines, as these in most cases are still carried overhead.

On Wednesday, April 5, a very interesting exhibition was held at the Natural History Museum, South Kensington, when all the subscribers to the British Ornithologists' Union Expedition to Dutch New Guinea were invited to inspect the first collections of mammals and birds. The expedition is still attempting to reach the Snow Mountains, but it will be remembered that two members of the party, Mr. W. Goodfellow, the leader, and Mr. G. C. Shortridge, have been invalided home. The latter brought with him a large zoological collection, including about 1100 birds and 100 mammals. These have now been examined, and though procured at a comparatively low elevation (none having been obtained above 21,000 feet), the birds especially are of the greatest value and rarity. Quite a number were hitherto unrepresented in the national collection, while some five or six appear to be new to science. One of the most notable acquisitions is a magnificent bird of paradise (*Xanthomelus ardens*), which is yellow, with an orange-scarlet head and tippet. A small series of this fine bird was sent home, including adults of both sexes and a male in immature plumage. Among the novelties we may specially mention two brilliantly coloured parrots belonging to the genera Cyclopsittacus and Aprosmictus, likewise a beautiful fruit-pigeon of the genus Ptilopus. The collections were much admired, especially the many brilliantly coloured species to be found among the birds of paradise, parrots, kingfishers, rollers, pittas, &c. The mammals, though less showy, were also of great interest, while the drawings by Mr. Shortridge of bows and arrows, stone axes and clubs, paddles, &c., were much admired. The ethnological collection has not yet arrived, but is sure to prove of special interest.

It has been commonly taken for granted that a convenient and effectual way of encouraging scientific research is by the foundation and endowment of prizes for investigations dealing with specified subjects. The results published in the *Rendiconti* of the Lombardy Institution, xliv. (2), 1, recently received, seem to indicate that such endowments not infrequently fail to accomplish the desired object. The institution offered seven prizes for scientific subjects, one medal for industry, one for agriculture, a prize for commercial success, and others for economical, philosophical, literary, and forensic subjects. The industrial medal was awarded to one of three competitors, and for the Brambilla commercial prize eighteen firms competed, nine of which received awards and medals; but only two awards were made for work in science, and none in agriculture. These results are the more remarkable in view of the subjects on which dissertations were presented. The competitors for the agricultural medal seem to have introduced substantial improvements in cheese-making, based on a scientific study of bacteriology, but were apparently disqualified because their process had not met with such universal adoption that further recognition was unnecessary. The prize founded for the cure of pellagra seems to have been unawarded, in spite of researches of considerable scientific value having been made in connection with this disease. But the most remarkable fact is that a prize offered for improvements in dirigible balloons has now remained unawarded for three consecutive years. At a time when aërial navigation has made its greatest progress, it should surely have been possible to find many Italian aviators or aëronauts worthy of a prize founded long before the days of aviation.

An exceptionally long spell of easterly and northerly winds has prevailed over the whole of the British Islands, continuing for four weeks with the exception of a break or two lasting only for a few hours, and there have only been four days to April 11 at Greenwich since March 4 with the temperature in excess of the average. The day temperatures were low in March, but the nights were often fairly warm, with the result that the mean temperature for the month was in good agreement with the average. Since April set in, the cold has intensified, and the day temperatures have been remarkably low for the time of year. At Greenwich the maximum shade temperature on April 5 was 36·1°, and on April 6 38·0°. The observations at Greenwich since 1841 only show one day with the maximum temperature below 40°, a reading of 36·3° being recorded on April 19, 1849. The lowest minimum temperature at Greenwich during the recent cold spell was 26·7° on April 6; this is not remarkably low and has been occasionally equalled of recent years. The mean temperature for the week ending April 8 was 37·9°, and apparently the Greenwich observations only yield one period of seven days in April with so low a temperature since 1841, the mean for the week ending April 10, 1888, being 36·4°. The mean of the maximum or day readings for the week ending April 8 this year is 43·1°, whilst for the specially cold week ending April 10, 1888, it was 44·1°, so that the recent cold spell is the coldest on record for April so far as the maximum temperatures are concerned. The summary of the weather for the week ending April 8 this year, just issued by the Meteorological Office, shows that the mean temperature for the period was much below the average over the whole of the British Islands. The coldest district was the south-east of England, where the mean for the week was 36·9°, which is 8·3° below the average of the past twenty-five years. The deficit amounted to nearly 7° in the east and south-west of England and in the Channel Islands, and to 6·4° in the Midland counties. During the middle of the week the thermometer remained abnormally low over the eastern and southern counties of England, barely exceeding 32° at a few places, and at Tunbridge Wells on April 5 the highest temperature was 31°. The lowest minima, recorded on April 5 or 6, ranged from 17° in the east of Scotland and 20° in the west of Scotland, to 26° in the north-east and north-west of England. Snow was of frequent occurrence in nearly all parts of the kingdom.

In *Man* for April Mr. W. L. H. Duckworth describes a skull of the second Neolithic period found in a mound at Tsangli in Thessaly, and now deposited in the Cambridge Museum. In form it is mesaticephalic, and a deep incesura subincutalis reduces the height of the mandible in front. This last character is almost the only distinctive feature of the specimen. If, as may be inferred from its association with objects of undoubted antiquity, this specimen is of ancient date, it proves the existence of a highly evolved type of cranial form in Thessaly at this early period, modern examples indicating that the more usual form of skull in this part of Greece is longer and narrower than at the earlier period.

Mr. H. St. George Gray, in his report of the third season's work at the Maumbury Rings, records some additional discoveries. The remains now disinterred include two skeletons of the Romano-British period, with two of later date. We have as yet no certain knowledge of the age of the surrounding embankment, which cannot be fixed without further excavation. Socket-holes indicate the position of the railing erected for the protection of the spectators, and at the bottom of the arena some most interesting ceramic remains were unearthed, establishing the fact that the shafts date from the Neolithic period. The pottery consists of pieces of a rude vessel, black in

colour, with a dull red-brick tinge on the exterior only. It was imperfectly fired, and was composed of flint, quartz, and bone, but without any trace of chalk, calcite, or any form of limestone.

Among the pressing wants for the study of the evolution of human culture in these islands is the establishment of a folk-museum to contain the numerous archaic implements and utensils still to be found in the more secluded parts of the country, but which are now rapidly disappearing. The Pitt Rivers Museum at Oxford does something to fill this gap in our collections, and if its accommodation and resources could be increased, the work of forming and arranging such a collection could not be placed in better hands than those of its present curator, Mr. H. Balfour. Mr. J. Edge-Partington, in the April number of *Man*, illustrates the abundance of such material by describing, with drawings, a series of such primitive domestic implements and vessels collected from farmhouses in North Wales, where they are rapidly disappearing from use. Many of these are of a very primitive type, such as the collar used to control rams in the rutting season, curious spades and knives, a dish used for the dipping of rush lights, and a grooved rolling-pin for making oat cakes.

The Bio-Chemical Journal for March (vol. v., Nos. 8 and 9) contains a memorial notice of Dr. Christian A. Herter, of New York, who recently died at the early age of forty-five. His greatest work was his study of the complex elusive diseases set up by the development of an abnormal bacterial flora in the intestinal canal.

A chart containing the essential features required for the description and identification of bacterial species has been issued by a committee of the Society of American Bacteriologists, consisting of Messrs. Chester, Gorham, and Erwin Smith. The chart is a most comprehensive one, and includes a glossary of terms; it deserves the serious consideration of all bacteriologists.

No. 39 of the Scientific Memoirs of the Government of India is by Lieut.-Colonel Sutherland, and discusses in much detail the applicability to medico-legal practice in India of the biochemical tests for the origin of blood stains. As regards the precipitin test, the age of the blood stain, at least up to twenty-seven months, makes no difference in the applicability of the test.

The report of Dr. Bashford, the delegate of his Majesty's Government to the second International Conference on Cancer Research, held at Paris in October last, has recently been issued. Among other subjects he directs attention to a paper dealing with certain tumours occurring in the sugar-beet and allied plants. These tumours can be grafted on to other healthy plants, and no causative parasite can be detected in them. From their general biological behaviour it appears justifiable to assign to them in the vegetable kingdom a position analogous to that occupied by cancer in the animal kingdom.

The fatality of fractures of the leg and of lobar pneumonia as deduced from hospital mortality rates, 1751–1901, is the subject of a statistical study by Messrs. Greenwood, jun., and Candy (Journ. Roy. Statistical Soc., lxxiv., part iv., 1911). It seems that the fatality of lobar or ordinary pneumonia has changed little during the last fifty years, the fatality of compound fractures of the leg has steadily diminished down to the present time, and the fatality of simple fractures of the leg diminished greatly and steadily down to fifty years ago, but since then the change has not been regular. The curious point is brought out that cases of simple fracture in the old days were kept in hospital often for months, and sometimes for much longer, and the patients frequently developed bedsores and an unhealthy condition, which resulted in death.

In a recent short paper (*Parasitology*, vol. iii., No. 3, 1910), Dr. A. E. Shipley records five species of pentastomids from various Indian and African reptiles, including a new species of Porocephalus from the tortoise *Kachuga lineata*. The most interesting fact in the paper, however, is the occurrence in the pharynx of an Indian crocodile, captured on the mouth of the river Hooghly, of *Linguatula subtriquetra*, a parasite hitherto known only from the American *Caiman sclerops*.

No. 6 of the fourth volume of the Records of the Indian Museum is devoted to a revision, by Miss G. Ricardo, of the Oriental gad-flies of the genus Tabanus. No fewer than forty new species, including one from Celebes (which the author excludes from the Oriental region) and three from other regions, are described in the monograph; on the other hand, a large number of reputed species are relegated to synonyms.

The Rugby School Natural History Society, of which we have received the report for 1910, is to be congratulated on a marked increase in the number of its members, of which the total is now 425. The activity of the various sections has been, on the whole, well maintained, while some of them have exhibited remarkable energy and enthusiasm in their work. An interesting innovation in the present report is a record of the scientific work of old members of the society.

A contribution to our knowledge of the modern reptile fauna of Africa is made by Mr. F. Siebenrock in vol. cxix., part vii., of the *Sitzber. k. Akademie der Wissenschaften*, Vienna, who describes, with four plates, a large collection of chelonians made by Messrs. Pöck and Brunnthaler in the south and south-west. Eleven species—none new—are recorded, of which *Homopus boulengeri* and *Testudo bergeri* are figured. Special attention is directed to a series of *T. oculifera*, which is regarded as of importance in connection with the evolution of the colour-pattern. In the author's opinion, this species and *T. geometrica* constitute in this respect a subgroup phylogenetically distinct from the other members of the same group.

Scales of fishes brought home by Dr. F. Hatch from the Ecca Shales, near Ladysmith, of which an account is given by Dr. Smith Woodward in part ii. of the second volume of the Annals of the Natal Museum (pp. 229–31), are of interest as affording further evidence of the existence of an abundant fauna of Palæoniscidæ in southern Africa during early Mesozoic and late Palæozoic times. Scales of the same general type have been previously obtained from the Karu formation of the Cape and the Permo-Carboniferous of Rhodesia and Nyasaland. The last-named were referred by Dr. Traquair in the Quart. Journ. Geol. Soc. for 1910 to Colobodus, while the Rhodesian and the new Natal specimens represent the genus Acrolepis, of which there may be two species.

The Times of March 27 devotes an article to the wild fauna of South Africa in connection with the forthcoming display in the Zoological Society's Gardens in Regent's Park of a representative series of South African animals, to be called the King's collection. The collection, which already includes a large number of species, is to be presented to his Majesty in commemoration alike of his Coronation and of the establishment of the Union of South Africa. According to the latest information from the

Cape, the animals are being drafted to various ports previous to their shipment for this country. It is unfortunate that a southern seal recently received at the gardens, which is to be included in the African collection, is alluded to in the article as Ross's seal (*Ommatophoca rossi*) of the Antarctic, whereas it is really, as pointed out by Mr. Pocock in *The Field* of April 1, a young specimen of the sea-elephant or elephant seal (*Macrorhinus leoninus*). It was obtained from the Crozets, and is the first living example of its kind received in the gardens, and probably in Europe. The young animal is very like Ommatophoca, having a short, blunt muzzle and very large eyes.

IN an article published in *The Fortnightly Review* for April, Mr. F. G. Aflalo records his impressions of the London Zoological Gardens on paying his first visit after a three years' absence from England. His impressions are altogether satisfactory, and he especially commends the removal of the society's offices to the gardens, as the result of which the whole establishment is under the immediate eye and control of the secretary. It is added that, "as a result of this new control, we have the evidences of success on all sides, not merely in the condition and housing of the animals, but also in the higher birth-rate, lower death-rate, and increase in the number of both fellows and visitors to the gardens." Commendation is also accorded to the systematic plan on which the whole laying-out of the gardens is being remodelled, so far as existing buildings will permit, and the erection of new buildings and the construction of new enclosures with the view of a striking and picturesque general effect. Such changes must, however, of necessity be slow and gradual, as their cost is great. With its distinctly unfavourable conditions of climate and soil, the "New Zoo" cannot hope to rival in all respects similar establishments situated under sunnier skies, but, nevertheless, it "has overcome many obstacles, climatic and otherwise, and the result is something of a triumph."

THE annual report for 1909 issued by the director of the Sydney Botanic Gardens and Government Domains contains a few illustrations, one of which provides a view of the Centennial Park and another illustrates a clump of trees of *Casuarina glauca* in the botanic gardens. The cultivation of succulents is receiving special attention, and an extensive planting of palms in the domain is recorded. Among the noteworthy plants under cultivation mention is made of *Beilschmiedia Tarairi*, a New Zealand silver-leaved tree, analogous to the copper beech; an Australian natural hybrid, *Brachychiton populneo-acerifolius*; and two native plants, a white-flowered composite, *Olearia Flocktoni* and *Drymophila Moorei* (Liliaceæ). The publications emanating from the department include parts of the Forest Flora and several pamphlets on useful Australian plants.

PARTLY for the purpose of comparison with the working of the forests of *Pinus longifolia* in the North-west Provinces of India, a description of the State pine forests of Landes and Gironde in France is contributed to *The Indian Forester* (December, 1910). The area of sand dune converted into forest amounts to 200,000 acres, and, in addition, there is a littoral dune and protective wooded belt of one quarter of that area. The dunes are controlled by fascines and plantations of marram grass. *Pinus maritima* is grown as a pure crop for timber and resin under a rotation varying from sixty to seventy-five years. The species seeds freely from about an age of twelve years. Tapping for resin begins on trees about thirty-five years old, and proceeds until the tree is cut down. Details of tapping, the instruments used, and distillation are given.

IN plant hybrids raised by crossing *Œnothera biennis* and *Œ. muricata*, Prof. H. de Vries has observed some distinct features, which are indicated in a preliminary paper published in the *Biologisches Centralblatt* (February 15). In the first instance, the reciprocal hybrids *bm*, *mb*, are distinct from each other and from their parents, although clearly resembling the parent from which pollen was taken. The two resulting hybrids were then reciprocally crossed, $bm \times mb$, $mb \times bm$, when the former lost all traces of the species *muricata* and the latter all traces of *biennis*. The conclusions are formulated that for these two species the pollen cells bear special characters not shared by the egg cells, and that the characters of the grandfather cannot be transmitted through the mother nor those of the grandmother through the father. Similar results, *i.e.* dominance of the male parent and elimination of the characters of the female parent, were obtained when either of these species was crossed with allied species.

IT may not be generally known that the annual lists of "Geological Literature added to the Geological Society's Library" (Burlington House, London) can be purchased by the public. The issue for 1910 includes books and papers received up to December 31 in 1909, and the subject-index enables a reader to refer to the geological work of the whole year under almost any heading that may be in his mind. We see, for instance, that eighteen authors have written on Colorado, ten on laterites, and five on Natica. The list is especially important as an index to the geological journals of the world.

MR. P. MACNAIR has prepared an "Introduction to the Study of Rocks" as a guide to the rock-collections in Kelvingrove Museum, Glasgow (1911, price 3*d*.). It is well illustrated by photographs of rocks in the field, in hand-specimens, and in thin slices. The rock-forming minerals are also described, with figures of characteristic forms. Objection may be taken to the description of quartz and calcite as hexagonal, and to ilmenite as a "ferriferous titanite"; but the notices of the minerals and rocks are clear and adequate. Numerous drawings of sections of Scottish rocks are included in the text, and the book is distinctly attractive as an introduction to petrography.

FOR the benefit of teachers of geography in the State, a series of chapters dealing with the geography of Ohio State, by Mr. F. Carney, are appearing in the Bulletin of Denison University. Those treating of transport, glaciation, and the economic mineral products, provide useful summaries of information relating especially to Ohio.

PROF. HUNTINGTON, in the February number of the Bulletin of the American Geographical Society, describes the Karst country of southern Asia Minor, where to the south and west of Konia many of the streams end in dark, deep pools, in which the water sinks slowly underground. Much of the country, and especially the great plain of Axylon to the east of Konia, is too dry to be fruitful unless artificially supplied with water. Considerable work is being done whereby the waters of lake Bey Shehir (Kirili Göl) will be diverted, by means of a canal, from the lower lake of Kara Viren, where much is now lost, and will be carried through the Charsbembeh gorge to the plain below, where it is expected to put about 350 square miles under irrigation when the canal is opened by the end of 1912.

IN the *Revue générale des Sciences* for March 15, M. F. Diénert discusses the report of the commission which has

investigated the floods of the Seine valley in 1910, and made recommendations to mitigate the disastrous effects of future ones. The predictions of the Hydrometric Service were, on the whole, very correct, but the coincidence of flood waves in different tributaries, and the reduction of the effective channel by bridge piers, quays, and floating structures resulted in widespread inundation of the city. Three works were recommended by the commission, each of which would entail considerable outlay, but one at least, to take a branch from the river Marne by Claye to Epinay, would be of considerable economic value also. The other projects, to widen the left branch of the Seine and to deepen it between Suresnes and Bongival, will also receive a further study.

The meteorologist of the Commonwealth of Australia has published his annual rain map of Australia for the year 1910, in which he shows that the coast lands in the south-west, almost the whole of the State of South Australia, or the States of South Australia and Queensland, northern New South Wales, and eastern Victoria received a rainfall above the average in 1910. This was especially so in the northern territory of South Australia, where the heavy fall was due to the activity of the monsoon rain influences. The difference between the actual fall in 1910 and the normal in some cases is very striking, showing frequently an increase of 50 per cent. The lowest rainfall, under 5 inches, was in central Western Australia. The highest, about 180 inches, was on the coast of Queensland half-way between Cook Town and Townsville. The district near Zeehan (Tas.) received above 100 inches.

"The Supposed Cold of Winter Anticyclones" is the title of a useful note by Mr. W. H. Dines in *Symons's Meteorological Magazine* for March. In an interesting summary of the weather of January, in the magazine of the previous month, reference was made to the striking exception to the old dogma that high barometric pressure in winter is almost invariably associated with persistent frost. Mr. Dines, who some years ago assailed that idea in the Quarterly Journal of the Royal Meteorological Society, now points out, *inter alia*, that during the 50 years 1841–90, the Greenwich records show 74 periods of frost. Out of these, 20 (with 216 days of frost) occurred with the mean of the barometer below 29·80 inches, and 13 (giving 93 days) with a mean above 30·20 inches. Every frost noted for severity or length had occurred in the low-pressure series. Also at Christiania, Berlin, and Geneva no connection between the monthly winter means of the height of the barometer and of the temperature is shown. The statement in question is still made in some text-books, and may possibly be true in drier countries, *e.g.* in Asia and North America. Kite and balloon observations have shown that the air a few thousand feet high during an anticyclone is unduly warm.

The climatology of 1910 is discussed in the usual annual summary which MM. Flammarion and Loisel contribute to the February number of *L'Astronomie*. The discussion is based on the daily observations made at the Juvisy Observatory, and the different results, in addition to being plotted all on one chart, are compared with the analogous monthly, seasonal, and yearly results registered during the past twenty-five years. The year 1910 was almost entirely a bad one from the weather point of view. An abnormally low barometer, which beat the minimum record for December, was accompanied by excessive humidity and rainfall, the number of rainy days (212) exceeding that of any year since 1893, while the amount of rain was 818·4 mm., or 275·9 mm. above the annual mean; its partition among the seasons was also abnormal. Although the mean temperature was the highest since 1906, the spring and summer were deficient in sunshine, there being 1555 hours spread over the 301 days on which sunshine was recorded; in 1909, 1970 hours were recorded for 300 days. In consequence of this state of sunless, cold humidity, the vine, wheat, and other crops met with disaster, and, as a "comet" year, 1910 compared very unfavourably with the legendary years 1811 and 1858.

An abstract of the first three of the lectures on "Radiant Energy and Matter," which Sir J. J. Thomson is delivering at the Royal Institution, will be found in *The Electrician* for March 24. The first lecture dealt with the measurement of radiant energy and the laws which have been found to connect the energy radiated with the temperature of the radiating body. The second dealt with the pressure which radiation exerts on the body on which it falls, and the applications of the results of experimental and theoretical work on this subject to cosmical problems. The third dealt with the visible radiations, their production by fire-flies and by illuminating engineers, and their perception by the human eye.

In the March number of *Terrestrial Magnetism and Atmospheric Electricity*, Mr. J. A. Fleming, of the department of terrestrial magnetism of the Carnegie Institution, describes two new types of magnetometer which have been constructed for land observations in districts more or less difficult of access. The first is a theodolite magnetometer for astronomical work and the determination of declination and horizontal force, the second is a universal instrument for astronomical work, declination, horizontal force, dip, and by Lloyd's method total intensity. In both cases the magnet system consists of a long and a short magnet each embedded in a brass cylinder of a standard size. The suspension is of phosphor bronze strip. The first instrument is built on the usual lines, but the reduction of size has necessitated changes of details. The second departs considerably from the traditional form owing to the combination of a dip circle with the deflection magnetometer. The two instruments, packed in their cases, weigh 11 and 13 kilograms respectively, and the degree of accuracy obtained by means of them is about the same as that secured with the older and much heavier instruments.

Messrs. Adam Hilger, Ltd., have sent us a copy of their new general catalogue, which should be in the hands of every worker in the ever-widening field of spectroscopic research. Not only are a large number of spectrographs figured and described, their special features and adaptability for various purposes are carefully explained, so that the book is something more than a mere catalogue. One of the many features to which the firm pay special attention is the quartz-spectrograph, with which we know excellent results have been obtained. These are now made in a large variety of forms, some of which are easily convertible, so that their action can be modified to suit the special end in view. An ultra-violet stellar spectrograph, giving a spectrum 50 mm. in length from λ 3000 to λ 8000, is quoted at 53*l*., and with its large angular aperture should prove a very effective instrument. A wedge spectrograph for technical use, designed by Dr. Mees for the rapid and permanent recording of absorption, transmission, and sensitivity curves, is sold, with the necessary accessories, at 17*l*. The catalogue also contains figures and descriptions of many accessories—gratings, slits, tubes, &c.—and of several special pieces of apparatus, such as

the echelon, the Fabry and Perot interferometer, &c. Those workers wishing to learn more of the latest forms of these special apparatuses should get section B of the catalogue, issued separately, in which, in addition to the descriptions, figures, and prices, complete bibliographies concerning them are given.

We have received the new edition of the "Descriptive List of Photographic Dry Plates, Filters, and Safelight Screens" manufactured by Messrs. Wratten and Wainwright, Ltd. (Croydon). The firm have recently installed apparatus for the critical examination of the effect of colour screens upon definition, a matter too often left to chance. With regard to the plates, &c., prepared specially for all kinds of scientific work, we notice specific statements as to those best adapted for photographing various parts of the spectrum, and the "high resolution plates," for which a "limiting separation of about 1/150th mm." is claimed, as against a separating power equal to about 1/40th mm. for ordinary plates. These special plates are slow panchromatic plates.

OUR ASTRONOMICAL COLUMN.

Detonating Meteor in Messina.—On Monday evening, April 10, at 7 p.m., people at Messina noticed a brilliant illumination of the sky, succeeded in about three minutes by four loud explosions like artillery discharges. The idea was that one of the ammunition magazines in a fort had exploded, but telegraphic despatches from Palermo, Catania, and Reggio di Calabria announce that a similar phenomenon had been remarked there, and that it had its derivation from a large bolide or some other meteoric disturbance. The interval of three minutes between the flash and sounds show that the disruption of the fireball occurred at a distance of about forty miles from the observer at Messina. More information is awaited. At other stations the object may have approached much nearer, if it did not, indeed, shower some of its disintegrated fragments to the ground. April 10 is a rather special date for large fireballs; it has furnished many fine specimens in past years.

Halley's Comet.—Writing to the *Astronomische Nachrichten* (No. 4489), M. Antoniadi shows that whilst Prof. Eginitis recorded the tail of Halley's comet as being directed towards the sun at 6h. 40m. (G.M.T.) on May 20, 1910, five observers who saw it at various short intervals before that time, and five who saw it after, recorded the tail as directed from the sun; only twenty-nine minutes separated the times of observation at Sonnwendstein and Athens, the former being 7h. 9m. (G.M.T.). Mr. Evershed, observing at Kodaikánal about 2h. (G.M.T.) on May 20, saw no trace of a tail directed towards the sun, although he looked specially for it.

The same number of the *Astronomische Nachrichten* contains a long series of observations of the comet made at Besançon (December 10, 1909, to June 29, 1910) and at Berlin (December 16 to June 10); M. Chofardet reproduces a drawing showing the magnificent fan which preceded the sharp nucleus on May 27.

Circulation in the Solar Atmosphere.—From an examination of 3323 prominences shown on photographs taken between January, 1904, and December, 1910, with the Rumford spectroheliograph at the Yerkes Observatory, Dr. Slocum has derived some valuable data concerning the circulatory currents in the solar chromosphere; the light of the H calcium line was always employed. Of the total examined, 1094 prominences, either by their shapes or movements, indicate a horizontal current, and as the average height to which these extended was 0·7′, or 30,000 km., the results represent the average poleward components of the solar atmospheric circulation from the lower surface of the chromosphere up to that height. Dr. Slocum finds that in middle latitudes there is a tendency for movement towards the poles, and in high latitudes a tendency towards the equator; near the equator the motion is practically negligible. The contrast between the two tendencies is greater in the northern hemisphere in the ratio of at least 2 : 1.

Among the earlier plates there were few which afforded data from which the velocities of the motions could be determined, but during the past year suitable plates for this purpose have been taken regularly. There is some difficulty in determining which of the observed movements may be ascribed to systematic circulation and which to local explosive outbursts, but ten selected cases give velocities of from 0·5 km. to 10 km. per second for the component of the circulatory movement which is perpendicular to the line of sight; one detached cloud, floating at an elevation of 442″, or 320,000 km., showed a velocity of 50 km. per second. Dr. Slocum points out that these results are not necessarily a contradiction to those obtained by Dr. St. John, who failed to detect any currents of appreciable velocity parallel to the solar surface; the two researches deal with different levels in the solar atmosphere. He further suggests that as his results depict the movements at an average height of 30,000 km., they probably apply to an upper current analogous to terrestrial anti-trades; a later discussion to deal with the different levels is promised (*Astrophysical Journal*, vol. xxxiii., No. 2, p. 108).

The Popularisation of Astronomy.—From *The Yorkshire Weekly Post* for April 8 we learn that the excellent idea of out-of-door astronomical talks has also been suggested by Mr. J. H. Elgie as a useful item in the programme of the Leeds Astronomical Society. For the past three weeks the society has been waiting, in vain, for a favourable sky so that they might hold the proposed Saturday evening meeting. Such meetings, open to the public, might easily be organised, and would probably do a great deal to dissipate the lamentable ignorance concerning the stars which is so frequently displayed by the general public.

The Antwerp Astronomical Society.—Among the many interesting matters recorded in the sixth annual report (1910) of the Antwerp Astronomical Society, it is of interest to learn that the society's observatory is being very generally used by a large number of students in the local schools, who, under the guidance of their tutors, visit the observatory and have the equipment, &c., explained to them. A new communal observatory is to be placed on the top of a school which is in course of erection in the city. An analysis of the observing weather during 1910, made by M. Felix de Roy, is also of interest. Of the 365 days in 1910, observations of the sun were possible on 269 days, and night observations were possible on 142; for 1909 the figures were 292 and 151; in 1908 there were 156 good nights; in 1907, 145; and in 1906, 102.

Spectroscopic Binaries.—The Journal of the Royal Astronomical Society (Canada, vol. iv., No. 6) contains the orbits of the spectroscopic binaries 93 Leonis and ϵ Ursæ Minoris as determined by Messrs. J. B. Cannon and J. S. Plaskett, respectively, from plates taken at the Dominion Observatory, Ottawa.

Mr. Cannon made two determinations, using micrometer measures in the first and the comparator in the second, and, judging from the probable errors of an average plate, there is but little difference between the two methods; fainter spectra may be measured with the micrometer than in the comparator, but with poor lines for measurement the latter instrument probably affords a better agreement among the measures. The period of 93 Leonis is found to be 71·7 days, and the eccentricity of the orbit is very small.

For ϵ Ursæ Minoris Mr. Plaskett finds a period of 39·482 days, a range of velocities of 63 km. per sec., and a small eccentricity; the velocity of the system is −11·398 km. per sec.

EXPERIMENTS WITH COAL DUST IN FRENCH COLLIERIES.

Soon after the dangers due to the presence of coal dust began to be realised in this country, and, as a consequence, regulations regarding the composition and methods of employing explosives in dusty mines had been added to the Statute-book, the number of great explosions occurring within a given time underwent such a remarkable diminution that for several years it seemed almost as if they were about to cease altogether. But a partial

recrudescence having set in later, it became apparent to those who were watching the course of events that complete immunity could not be attained until measures were adopted for dealing with the coal dust in the haulage roads, as well as at the points at which blasting shots were about to be fired. It was equally apparent that no far-reaching legislative action such as this could be taken unless the mining community, which had hitherto regarded the dangers of coal dust as more or less hypothetical, could be convinced of their reality, by ocular demonstration on a large and imposing scale. Accordingly, when called upon to give evidence before the Royal Commission on Mines some years ago, the present writer and others recommended the construction at Government expense, at an estimated cost of 10,000*l*., of a large apparatus to be used for this purpose. It is, perhaps, needless to remark that the Treasury declined to find the money, just as they had, some twenty-nine years ago, declined to find 5000*l*. for the construction of a similar gallery, 500 feet long by 6 feet in diameter, intended to be used for the same educative purpose, when asked to do so by the Royal Commission on Accidents in Mines, for one of the members of which (Sir W. Thomas Lewis) the present writer had obtained tenders.

The suicidal blindness of this kind of policy from a national point of view must surely be becoming apparent. It was at this juncture that the Mining Association of Great Britain stepped in and erected the experimental gallery at Altofts Colliery, which has been already described in a previous review (Nature, February 9, vol. lxxxv., p. 487).

When it was recognised in France that the explosion at Courrières Collieries, which claimed more than 1100 victims in 1906, was due to coal dust alone, the opposition which the Commission du Grisou had, up to that time, maintained against the coal-dust theory was effectually crushed, and it became necessary for those responsible for the safety of French mines either to accept the data regarding the behaviour of, and means of dealing with, coal dust already accumulated in other countries, or to accumulate quasi-original data of their own. The opportunity of adopting the latter alternative presented itself when the Comité Central des Houillères de France agreed to find a capital sum of 14,000*l*. wherewith to provide experimental appliances, and an annual income of 3000*l*. a year for current expenses as long as the experiments are continued.

The appliances which have been set up at Liévin Collieries in France are similar to, and intended to serve the same purposes as, those at Altofts and other experimental stations.

The experiments are being conducted by M. Taffanel, a member of the Corps des Mines, who has issued consecutively a number of very clear and able reports, describing the appliances, the methods of using them, and the results obtained with them.

In attempting, in his first report, to justify the attitude of antagonism to the coal-dust theory which his colleagues had just abandoned, he essays to throw a dart at the work of the present writer, but the weapon, having the form of a boomerang, naturally descends upon the unhappy heads of those he is trying to protect. It could not well be otherwise, for his subsequent voluminous descriptions of the mode of occurrence of a coal-dust explosion, the functions of the condensed and expanded waves and the position of the flame in the former, the influence of the weight of dust in a given volume of air, its fineness, the proportion of volatile matter contained in it, and the presence of more or less inert matter and moisture, had all been anticipated in the work in question; so that his own contributions to the subject, when divested of a vast amount of prolixity and a great array of numerical data, much of which is of doubtful, and most of only hypothetical value, largely partake of the nature of plagiarism.

Numerical data obtained by means of experiments of this kind are of no practical value except in so far as they can assist us in devising means for putting an end to great explosions. Thus, as it is known that the flame of an explosion in a mine can ascend to the top of a damp or wet shaft 900 or 1000 feet deep, it is not of the least importance to know whether an explosion in an experimental gallery can or cannot leap across a dustless zone a few hundred feet in width, and raise and ignite coal dust lying at its farther side. It is equally unimportant to know with what velocity the flame travels in, or what particular pressure is exerted by, an explosion of dust of greater or less fineness, or containing more or less volatile matter, since we are absolutely powerless to regulate any one of these conditions in a dusty mine, and know that an explosion, once begun in it, will spread as far as there is coal dust to maintain it.

In further attempting to cover the retreat of his comrades, M. Taffanel pleads that they had no previous experience of coal-dust explosions in France before the one at Courrières Collieries. But the present writer has a lively recollection of reading the accounts of two great explosions at the Jabin pits in France, which occurred one after the other within a short period of time, some thirty or more years ago, and of making a mental note at the time that, judging by the phenomena as described, they were both due to coal dust and not to firedamp, as was then announced. Again, surely M. Taffanel does not now seriously contend that the four great explosions, Chatelus, 1887, Verpilleux, 1889, Pelissier, 1890, and Manufacture, 1891, were attributable to any other agent than coal dust.

We frankly agree with M. Taffanel that his countrymen are, as a rule, in the van of progress; that although they did not originate the method of measuring the proportion of firedamp in the air by means of the firedamp cap (*for this see* Proc. Roy. Soc., vol. xxiv., pp. 361 to 367), they have produced an excellent lamp for the purpose; and that their appliances and regulations for dealing with firedamp, and for blasting, are amongst the most perfect in existence, and we heartily congratulate him and them upon the results of these measures. But *qui s'excuse s'accuse*: and the mere fact that they have been able to perfect their methods of dealing with firedamp makes it all the more regrettable that they so resolutely refused to believe in the dangers of coal dust, since it is practically certain that had they lent their powerful aid to the solution of that question from the beginning, it would have been settled long ago, and at least two Royal Commissions which examined the subject successively in this country would have been saved the ignominy of making halting and half-hearted suggestions for grappling with it.

The first series of M. Taffanel's experiments was made with an auxiliary apparatus consisting of two pieces of sheet-iron pipe, each 25 feet long by 2 feet in diameter, placed side by side and connected to each other at each end by short pipes of the same diameter. The air was made to circulate through this system by means of a fan working at the middle point of one of the longer pipes with sufficient rapidity to keep fine dust suspended in it, and shots were fired from a cannon into the dust-laden air from one end or the other of the second long pipe. By this means it was ascertained that dust containing 11·3 per cent. of volatile matter (ash and moisture deducted) could not be ignited by the explosion of a half cartridge of gelatine dynamite fired electrically from the cannon without tamping, but that dust containing 15·4 per cent. and up to 53·2 per cent. could be invariably ignited when the air contained a minimum weight of 138 grammes per cubic metre of that with 15·4 per cent. and 40 grammes per cubic metre of that with 53·2 per cent., and similarly an intermediate weight for all intermediate proportion of volatile matter.

The second series of experiments was made with the same apparatus (the shots being fired in the direction of the air current), one set to ascertain the effect of varying the weight of the explosive, the other to determine the effect of mixing the coal dust with slate dust. The coal dust employed was prepared with Liévin coal containing 29 to 30 per cent. of volatile matter and 3 to 5 per cent. of ash, and of such a degree of fineness that only 5 per cent of it was unable to pass through the sieve with 5625 meshes per square centimetre.

By these experiments it was ascertained, first, that a certain minimum weight of explosive was sufficient to produce ignition, and that increasing that weight made little or no difference in the length of the resulting coal-dust flame; and, secondly, that the addition of slate dust to the coal dust reduced the velocity of propagation of the flame, although inflammable clouds were obtained with as much as 62 per cent. of slate dust, and it seemed doubtful whether under certain conditions propagation would not take place with as much as 78 per cent.

These results are to some extent in keeping with those btained by the present writer on June 5, 1896, when he nade the first experiments of this kind with mixtures of ombustible (in that case lycopodium) dust and inert dusts chloride of calcium, dry clay, common salt) at University College, Cardiff, in the presence of Mr. Robson, then Chief nspector of Mines for the South Wales district, and Mr. 'aughan Nash.

The third series of experiments was made with the rincipal gallery, which in 1908 was 71 yards long, in 1909 vas lengthened to 250 yards, and in 1910 to 328 yards. The first 33 yards of its length is constructed with ferro-oncrete specially strengthened with steel joists. Its form s trapezoidal in cross-section, and its internal dimensions re 6 feet high, 4 feet 7 inches wide at the top, and feet 3 inches wide at the bottom. This shape and these limensions were chosen with the object of assimilating its nterior to that of a roadway in a mine, and the similarity s still further accentuated by means of props and caps set p at the usual distances apart in its interior. In its final orm, so far as one can gather from the descriptions, the emainder of the gallery is constituted by a sheet-iron ylinder, 6 feet in diameter, with one of its ends abutting gainst one end of the ferro-concrete section and its other nd open.

Two massive stone walls, one on each side of the free nd of the ferro-concrete part of the gallery, extend back-vards from the latter to a distance of 10 or 12 feet, and onstitute supports to a vertical barrier of strong wooden eams, with which that end is closed. The cannon from vhich charges of explosive are fired for the purpose of gniting mixtures of firedamp and air, or of raising and gniting coal dust in the interior of the gallery, can be fired orizontally at any desired height in the vertical centre-ine of the latter, with its muzzle extending through a ole in, and flush with the inner face of, the wooden arrier. Its bore is 2 inches in diameter and 23½ inches eep, and, except where specially mentioned to be otherwise, ts axis was placed at a height of 2 feet above the floor. The explosive employed was gelatine dynamite fired without amping by means of an electric fuse, and the minimum veight of charge that assured propagation of the coal-dust lame under ordinary conditions was 160 grammes.

A branch gallery built of masonry, connected at right ngles to the main gallery at a distance of about 17 feet rom its closed end, serves the purpose of a channel, through vhich air can be blown, by means of a ventilating fan, into nd through that gallery, and also affords a means of ngress to and egress from it.

When an explosion is about to be produced, the connec-ion between the main and branch galleries is cut off by losing a strong door at their point of junction.

There are twelve plate-glass windows about the middle eight of the ferro-concrete part of the gallery, through which the progress of flame in its interior can be seen from distance. Its cylindrical prolongation, on the other hand, embedded in the centre of a mass of debris, like a rail-ay embankment, about 6 feet high by 12 feet wide at the p, and with sloping sides.

The coal dust employed in the experiments is obtained by rinding coal as it comes from the mine, first in a ball-ill, and secondly in an Alsing pulveriser. The degree of neness attained in the latter depends upon the length of me during which the grinding is continued.

After having been first granulated in the ball-mill and en ground in the Alsing pulveriser for the length of time amed below, the following proportions of Liévin coal are rrested by a sieve of brass wire with 5625 meshes per quare centimetre,[1] viz. :—

Time	Per cent remaining on seive
0 minute	72·5
15 ,,	35·0
30 ,,	12·5
45 ,,	3·5
60 ,,	1·5

Some analyses of the same coal employed in the experi-ents are as follows :—

	Per cent.	Per cent.	Per cent.
Volatile matter (including moisture) ...	28·00	25·07	29·50
Ash ...	8·57	12·16	5·97
Volatile matter (exclusive of ash ...	30·60	29·30	31·40

The weighed quantity of dust employed in each experiment was scattered uniformly over the floor of the gallery by hand; that remaining unconsumed after the experiment was partly swept, partly blown out, by means of a strong current of air from the fan; and when it was desired specially to cleanse the gallery, jets of compressed air were employed for the purpose.

When it was desired to effect the ignition of the dust by means of an explosion of firedamp and air, part of the gallery next the wooden barrier was isolated by means of a paper diaphragm in exactly the same way as was first done for the same purpose in the Royal Society gallery of 1880–1, and afterwards in the Prussian gallery of 1884, and the gas and air already mixed was introduced into it in exactly the same way as an accurately measured quantity of firedamp was introduced into the isolated part of the Royal Society gallery, in which it was mixed with the air by being drawn into the centre and expelled from the periphery, of a rapidly revolving fan in the interior of the gallery itself.

The apparatus employed for measuring pressures is of the "crusher type," such as is employed in testing explosives. It consists of a cylinder, containing a hollow piston with a block of lead in its interior, and a small steel ball interposed between the block of lead and a fixed support. The pressure acts on the piston which presses the lead against the steel ball, and the latter, being prevented from moving by the fixed support, penetrates the lead to a greater or less depth. In spite of the extreme accuracy with which it is professed that the depressions produced in the lead block can be measured, a more clumsy and probably inaccurate method of measuring the comparatively small pressures here requiring to be dealt with could hardly well be imagined.

The appliance for measuring velocity, which consists of a counter marking fifths of a second, started at the moment the explosion commences and stopped by an observer when the flame appears at the end of the gallery, the length of which for this series of experiments appears to have been 65 metres only, seems to be hardly less trustworthy than the pressure recorder.

On the other hand, the flasks for collecting samples of the products of combustion immediately after the passage of the flame, from which the air had been extracted beforehand, and into which nothing could enter until a sealed glass tube which communicated with their interior had been broken by a detonator ignited by the flame of the explosion, seem to be satisfactory.

The firedamp employed in some of the experiments was obtained from the pit near at hand, stored in a gasometer, and mixed with air in the proportion of 9 or 10 per cent. before being introduced into the isolated part of the gallery in the manner already indicated.

Of all the explosives tested, dynamite was found to produce coal-dust explosions with the greatest facility. It was found that the explosion of 8 cubic metres (282½ cubic feet) of a mixture of firedamp and air, when ignited by means of 100 grammes of black powder, easily gave rise to a coal-dust explosion under favourable conditions; but that under less favourable conditions the superposition of a firedamp explosion upon that of dynamite actually diminished the chances of propagation. M. Taffanel's attempt to explain this phenomenon, by supposing that the large quantities of carbon dioxide and water vapour projected into the dusty atmosphere in consequence of the combustion of the firedamp are responsible for this result, is altogether erroneous. The true explanation is that the expanded wave, following after the condensed wave in the *cul-de-sac* constituted by the little gallery, overtakes and extinguishes the flame. The present writer observed the same phenomenon in his smaller Royal Society gallery of 1877–8, and succeeded in destroying the expanded wave and securing free propagation of the coal-dust explosion on every occasion by providing a flap-valve, opening inwards only, at the closed end of the gallery, through which air was drawn with sudden violence an instant after the firedamp mixture had exploded; and he has no doubt that M. Taffanel would have exactly

[1] Comite Central des Houillères de France Station d'Essais de Liévin-oisième Serie d'Essais, p. 9 (1910).

the same experience if he provided either a similar valve or a reservoir of air of sufficient capacity near the closed end of the *cul-de-sac* (such as exists in the form of branch workings in most mines), from which air could expand and thus wholly or partially destroy the vacuum. If he arranged his experiment in this way, he would have no difficulty in securing propagation by means of a firedamp explosion ignited by a spark, much less by 100 grammes of dynamite.

Many other points of importance might be referred to with advantage, but space would fail us were we to attempt to go further in this place, and the final remark we would make in regard to this series of experiments is that the water employed in damping the dust, which forms globules on the surface of the latter, does not appear to have been applied in the form of an exceedingly fine spray, repeated several times, in succession, with a short interval between each application, and we venture to think that if this had been done the results would have been different from those actually experienced.

The fourth series of experiments was made with the gallery lengthened to 230 metres (251½ yards), although the whole length was not always employed. For the first 32½ yards the form of the gallery was trapezoidal, with a lining of cement, the remainder cylindrical, with a lining of wood and with a floor. The coal dust was prepared from Liévin coal, with 29 to 31 per cent. of volatile matter and 6 to 12 per cent. of ash. The slate dust employed in some of the experiments was obtained from the pit. It contained 9 per cent. of volatile matter and 87 per cent. of ash, and was mixed with marly chalk, clay, siliceous sand, and boiler-furnace cinders. Mixtures of coal dust and inert dust were prepared by grinding them together. The mixture was simply spread uniformly on the floor and not stirred up mechanically before the explosion. The charge employed in creating the explosions consisted of 240 grammes of gelatine dynamite untamped and fired electrically, the axis of the cannon being 15¾ inches above the floor.

Fine dust was spread to a distance of 16½ feet in front of the cannon to insure ignition, but beyond that point coarser dusts ground for a quarter or half hour and even grains were employed.

Some explosions effected with half-hour dust were very violent, traversing the whole length of the gallery in 1⅓ seconds, with increasing velocity, which exceeded 1100 yards per second at the orifice, while the pressure, which was 28½ lb. per square inch for most of the distance, increased to between 42½ lb. to 71 lb. per square inch at 45 metres from the orifice, and to 156½ lb. per square inch at 11 yards from the orifice. With 900 grammes per cubic metre of quarter-hour dust, the flame traversed the gallery in 1·23 seconds, and the pressure attained 224 lb. per square inch at 10 metres from the orifice.

With a deposit of coal dust containing up to 33 per cent. of slate dust the coal dust was exploded, and the explosion was capable of becoming violent.

Passing over the experiments with dustless, watered and shale dust zones, and those made with obstacles of various heights, placed on the floor and on shelves at the sides of the gallery, we come to what are the most novel, and perhaps also the most interesting, of all the experiments, namely, the efficient results obtained in the way of arresting even violent explosions by placing loose, easily displaced cinders, or, *mutatis mutandis*, half-round sheet-iron tanks 40 inches long by 8 inches in diameter, filled with water on transverse planks one metre apart just under the roof of the gallery. It is to be hoped that these two methods of arresting explosions will be the object of further successful experiments, and it is not improbable that, after all, we may owe to France a debt of gratitude for pointing out a simple and efficacious means of effecting the object which all of us are so anxious to attain. May the present writer suggest in conclusion that possibly appliances of the nature of extincteurs or fire extinguishers, put into operation by the blast which precedes the flame of an explosion acting upon a movable vane which would open the passage for the escape of their contents, might be used instead of open troughs filled with water? The former would possess the indubitable advantage that they would retain their efficiency intact for any length of time; whereas the latter would require constant attention in the way of cleaning and refilling them. W. Galloway.

THE INSTITUTION OF NAVAL ARCHITECTS.

The spring meetings of the Institution of Naval Architects opened on Wednesday, April 5, at the rooms of the Royal Society of Arts. Owing to the death of Earl Cawdor, president of the institution, the chair was taken by Sir W. H. White, who announced that the council recommended the election of the Marquis of Bristol as president. The grant of a Royal Charter of Incorporation has received the Royal assent. The celebration of the jubilee of the institution, postponed from last year, will take the form of an International Congress on Naval Architecture and Marine Engineering, opening on July 4.

Fourteen papers were read and discussed. The problem of size in battleships was dealt with by Prof. J. J. Welch. Among other points raised in this paper is the contention that large dimensions expose a greater target to attack, a contention which must now be expanded to include the additional menace of missiles from dirigibles or aëroplanes. Assuming the attack to be delivered from a height of one mile, and therefore reasonably out of range of high-angle fire, a hollow bomb carrying 100lb. of explosive would take about twenty seconds to reach the water level, and would then have a striking velocity of about 500 feet per second. In twenty seconds a ship would change position some 540 feet, supposing her to be proceeding at 16 knots, and the probabilities of such a vessel being struck from above would be decreased if, at the moment of discharge of airship weapon, her helm were put hard over. The time, however, would not suffice to allow the vessel to sweep clear of her previous track before the missile reached water level, although the exposed area of deck in that track would be very much smaller than before. The difficulties associated with correctly judging speeds of battleships from the height named, and making proper allowance for cross wind currents, &c., combine to render a hit very uncertain if a single missile only is employed. It is stated, however, that arrangements are being made for dropping a number of such missiles from a single dirigible, in which case this form of attack would become a serious menace. It seems reasonable to suppose that the best protection from such attacks will be found in the counter-attacks by the same type of air-ship, associated with high-angle gun fire from the vessel attacked.

The Hon. C. A. Parsons and Mr. R. J. Walker gave the results of twelve months' experience with the geared turbines fitted to the cargo steamer *Vespasian*. In this vessel, the reduction of speed ratio of 20 to 1 is obtained by means of a spur wheel and pinion having double helical teeth. The vessel has now steamed 20,000 miles, and inspection shows that the wear in the teeth so far seems to be a negligible quantity. With the view of experimenting with different qualities of steel, a pinion of chrome nickel steel of tensile strength 55 tons per square inch, elastic limit 38 tons, and an elongation of 20 per cent. in a length of two inches, was tried and removed after two voyages. The corners of some of the teeth were found to be fractured, probably owing to irregular machining and to the material being too brittle. The original pinions were of mild chrome nickel steel of tensile strength 37 to 38 tons per square inch, and an elastic limit of 32 tons per square inch. These were replaced and have now carried the vessel more than 18,000 miles. A very noticeable feature has been the absence of racing of the engines under conditions when the propeller has been entirely out of the water. It is very difficult to observe any acceleration in the speed of the engines without the aid of a sensitive tachometer. This is owing to the very great angular momentum of the turbine.

Mr. G. S. Baker contributed a fully illustrated description of the National Experimental Tank and its equipment, including the model-making apparatus.

The whole of Thursday morning was taken up by a paper on Diesel engines for sea-going vessels, by Mr. J. T. Milton, of Lloyd's Register, a paper which provoked a very interesting discussion. Inducement to forsake the steam engine for ordinary sea-going vessels will be mainly the question of fuel economy. Even this important point would not of itself warrant a change to a new type of engine unless equal certainty of continuous efficiency on the voyages to be undertaken was provided, that is, as little risk of accident to machinery and as great facility for using temporary expedients for reaching port in case of break-

down of part of the machinery. There must also be a prospect of a reasonable cost of upkeep. Leaving warships out of account, oil fuel is only used on shipboard in those cases where the natural advantages render its use more economical than coal, and by vessels which trade regularly to ports where supplies can be obtained. For the ordinary cargo steamer which has to seek employment all over the globe, coal is still the necessary fuel.

The Diesel engine for marine purposes is made in three forms, viz., as a four-stroke cycle single-acting engine, a two-stroke cycle single-acting engine, and a two-stroke cycle double-acting engine. An auxiliary air compressor capable of producing a pressure of about 700lb. per square inch is required. The author has examined the turning moment diagrams of different arrangements of cylinders, and shows that a four-stroke cycle engine with twelve cylinders, a two-stroke with six cylinders, and a double-acting with three cylinders give fairly uniform Forsion moments, the ratio of maximum to mean being not greater than 1·15. With these numbers of cylinders there is nothing further to be desired regarding steadiness of motion. The Diesel marine engine should be Diesel only as regards the cylinders and their accessories, and should be of the ordinary marine type as regards all the rest of the engine. The question of the auxiliary machinery required is fully discussed in the paper.

Dr. Diesel stated in the discussion that any kind of oil may now be used in these engines, and that the use of the two-stroke cycle may be assumed in future for marine purposes. Some 250 vessels are now fitted or to be fitted with Diesel engines, a large number of these being submarines. The use of Diesel engines in submarines has so extended their radius of action as no longer to limit their use for coast defence merely. About 1000 horse-power is the largest power obtained from one cylinder up to the present, the cylinder being of the two-stroke double-acting type. Some makers are prepared to give higher powers from one cylinder.

Messrs. Richardson, Westgarth and Co., of Middlesbrough, are now constructing a set of single-screw Diesel engines of 1000 horse-power for a 3200-ton ship to the order of Lord Furness. These will be of slow-running type. The Anglo-Saxon Petroleum Co. have on order a single-screw vessel of 4250 tons to be fitted with 1100 horse-power Diesel engines, to be built by an Amsterdam firm.

Considerations affecting local strength calculations form the subject of a paper by Mr. J. Montgomerie. It is a truism that there is no such thing in the calculations dealing with the strength of ships as an actual quantitative stress in tons per square inch. "To design a ship from first principles" is a phrase which is often used in a sense implying far too much. All calculations of the strength of ships are comparative. Structural arrangements of vessels which have stood the test of experience are taken, and are compared and contrasted with those proposed in any given case, or a corresponding arrangement is derived from them which shall be satisfactory in the case being dealt with. It is of importance to eliminate, so far as possible, errors lying at the root of the comparison. For example, the comparison of a beam of symmetrical section with another of unsymmetrical section by use of the ordinary beam formulæ may produce very large errors. Again, errors often arise through want of proper consideration in cases of combined normal and shearing stresses. The effect of altered flexibility in a proposed arrangement often causes an entire change in the basis of comparison, and is generally uniformly neglected. Recent experimental work by Lilly on columns and Bach on flat plates was referred to. In connection with the latter subject comparatively little is known experimentally for rectangular plates fixed at the edges, and Dr. Thearle announced that the committee of Lloyd's Register had made a pecuniary grant to the author of the paper to assist in enabling further experiments to be carried out.

The acceleration in front of a propeller is the subject of a paper, in which Dr. R. E. Froude resists the inroad which a propulsion paper read by Prof. Henderson last year makes upon Dr. Froude's paper of 1889. The principal purpose of the latter was to prove from hydrodynamic theory that, in so far as the fluid acceleration by which thrust is satisfied may be treated as external to the propeller, one-half of that acceleration must take place before the propeller in obedience to defect of pressure in front of it, and the other half after it, in obedience to excess of pressure behind it. Prof. Henderson's paper of last year purports to prove, also from theory, that the precedent acceleration cannot possibly contribute to thrust. In the present paper Dr. Froude reasserts his theory, together with such further considerations as appear to be called for by Prof. Henderson's paper.

Herr H. Frahm contributes a paper giving the results of trials at sea of his anti-rolling tanks. Reference has already been made to Frahm's arrangement in NATURE. When in full action, the tanks on the ss. *Ypiranga* and *Corcovado* exert a turning moment of 2790 foot-tons, thus counteracting wave impulses of equal turning moment. In order to obtain equal efficiency in damping out rolling, the same turning moment ought also to be exerted by any other anti-rolling device, such as a gyroscope, which might be fitted to these ships. It is doubtful if it will be possible to develop the gyroscope sufficiently. The ss. *General* (13,620 tons loaded displacement), of the German East African line, started on her maiden trip at the beginning of March. When crossing the Bay of Biscay, she encountered a storm which made her roll 14° on either side when the tanks were out of action. This was reduced by 7° or 8° when the small fore tank was put into action, and with both tanks in action, the rolling was reduced to 3° in either direction. A large working model was shown in the library of the Royal Society of Arts. The ship was set rolling in a tank by means of an electromotor, operating on the model by means of a very flexible flat spring. The model showed very clearly the efficiency of Frahm's tanks in reducing rolling.

Prof. E. G. Coker describes his optical method of investigating stress in plates of variable sections, and gives some applications to ship's plating. The method has been already noted in NATURE, and it may be now added that the author has developed a method of obtaining the stresses quantitatively. This may be done by subjecting a standard test-piece to such a degree of pull or push that the colour produced agrees with that at a desired point in the body under examination. Or by a method modified so as to get rid of the necessary judgment in matching colours; this modified method may be used in all cases of pull or push stresses, and consists in arranging a simple pull or push member in the same field of view as, and immediately in front of, the object under examination. To determine the stress at any point, the reference member is loaded until the original dark field produced by the optical arrangement reappears. When this happens, the stress in the reference member is the same as that at the point considered, and no correction is required for the alteration in thickness produced by the stress, since both test pieces are in exactly the same condition.

STATE SURVEYS.[1]

THE true economy of executing land measurement of the highest precision as a control upon more detailed work, which can then be done more quickly and at less cost, is now generally admitted, and wherever the area is large such control work is carried out by a central administration for the use and assistance of local surveys. Methods will vary in different areas and with the special object in view, but such coordinated work on a large scale has great advantages over small scattered areas in which work is carried on independently.

(1) The operations of the Survey of India during the twelvemonth ending September 30, 1909, are described in the report which has just been issued. Primary triangulation was carried on in Beluchistan, Kashmir, and Burma over an area of 9600 square miles, besides a certain amount of building and selecting station; the average triangular of three groups completed were 0·41″, 0·6″, and 0·47″. The 10-foot standard bar A having returned from Sèvres, whither it had been sent in 1908 for comparison with the international metre, was recompared with the secondary standard bar of the Survey, and the results show that it is

[1] (1) "General Report on the operations of the Survey of India." By Col. F. B. Longe, R.E. (Calcutta, 1910.)
(2) United States Geological Survey, Washington. Bulletins 434, 437. Spirit Levelling, 1896 to 1909.
Bulletin 440. Results of Triangulation and Primary Traverse, 1906-8.

improbable that any change took place in its length between the time that it left India and its return from Sèvres, so that the value of bar A, viz. 3047·996 mm. at 62° F. in terms of the international metre, is thoroughly trustworthy. Pendulum work was carried on in the western tracts of the Sátpurá hills and the Vindhyan plateau as an investigation of the variation of gravity in the northern portion of peninsular India, and at seven stations, situated at from 750 feet to 2100 feet above sea-level, excesses of gravity were found. At twenty-eight stations above 750 feet hitherto observed gravity has never been in excess, so that dissimilar conditions in peninsular and extra-peninsular regions seems to be indicated. Subsequent seasons' work is being extended over Rajputana and the Sátpurá hills to the Gangetic plain. Tidal records from nine stations, Moulmein being one which was re-established, and nearly 1100 miles of double levelling, occupied a portion of the staff, while the Magnetic Survey working in Burma completed the preliminary survey with a total of 1255 stations.

Some specially disturbed areas were surveyed in detail, and this work is being continued. Heavy prolonged rain at Dehra Dun eventually forced its way into the magnetograph room, and, rising within an inch of the top of the driving-clock pillar, necessitated the removal of the instruments on August 15, which were replaced a month later. The Topographical and Forest Surveys also completed the survey of a large area of country. In cartographic work, the results of the reorganisation of the drawing, engraving, and printing branches which was carried out since 1906 are now to be seen, and the publication of standard map-sheets has kept pace with the survey and drawing, besides there being a considerable increase in outturn. A specimen sheet of the 1 : 1,000,000 map, the strategical map of India, is given, containing the region round Bombay; roads, railways, and boundaries are strongly brought out, but the relief is shown by shading, which renders main features prominent, and by comparatively few inscribed altitudes.

(2) The Bulletins of the United States Geological Survey, which deal with higher surveying, furnish the final results of work done in the field after all corrections have been applied. The numbers stamped on the bench marks in the field represent the elevations to the nearest foot above mean sea-level as determined by unadjusted levels in the field, and those who require a higher accuracy than 2 feet must consult these bulletins or apply to the offices of the Survey. The levelling is classified as precise or primary according to the accuracy of method and precision of the instruments employed, and lines are run both forward and backward in the former case, but in one direction only in the latter. The allowable limits of error in feet are respectively $0{\cdot}017\sqrt{D}$ and $0{\cdot}05\sqrt{D}$, where D is the distance in miles. In the bulletins the position of each bench mark is described and its altitude given to 0·001 foot for both classes of work.

The results of triangulation and primary traverse are likewise given in periodical bulletins, which not only give the description of each station, its mark and reference mark, and geographical position, but also the azimuth, back azimuth, and the logarithm of the distance from it in metres of all points observed from it. An interesting map of the United States is included showing the astronomic location and primary control up to January 1, 1909. While much has been accomplished, large areas remain along the 101st meridian, in the Southern States, and many other parts to be completed.

THE STANDARDISATION OF COLOURS.

UNDER the title of "International Rules for the Specification of Colours," Mr. Hans-Jacob Möller has reprinted an essay by him from the Journal of the Danish Apothecaries' Association (*Archiv for Pharmaci og Chemi*, November 14, 1910) showing the importance of having an international scheme of colours so as to enable reference to be made to a definite tint on a definite scale, and recommending as the most useful and most practical scheme of the kind that drawn up by Klincksieck and Valette, a scheme based upon the original system drawn up by Chevreul. There can be no doubt that such a colour scheme, recognised throughout the scientific world, would be of great practical value. For example, to take a very obvious instance, a large number of chemical reactions in connection with organic substances, such as dye-stuffs, depend upon colour changes, and if it was possible to describe these colour changes in accurate language, it would be of great practical value to the chemist.

When we come to the departments of pigments and of dye-stuffs, it is obvious that there, too, a definite recognised colour scheme would be of great practical value. It would, however, probably be better, if once a colour scheme was decided upon, that it should be reproduced in some permanent material such as coloured glass, so as to give a definite standard for reference at any future time, as a colour scheme which is merely lithographically printed may alter owing to fading of the colours, and if an attempt is made to repeat it, it is seldom that pigments can be twice reproduced with exactly the same tint.

On the other hand, an attempt to refer to definite lines on the spectrum is difficult in practice, as the use of the spectrum in this way for the matching of colours is not very easy, and it is not a satisfactory method. Mr. Möller does not refer to Lovibond's work on this subject and his scheme of coloured glasses. The present writer has found the Lovibond tintometer most useful and capable of very accurate matching, though the Lovibond standards are purely arbitrary. An arbitrary scheme seems the only possible one, and therefore, as Lovibond has devoted so much ingenious labour to the making and matching of his coloured glasses, there is a great deal to be said for defining tints by means of his tintometer, such a tintometer being kept as a standard of reference. Whatever may be determined, however, as the best practical solution of this question, it is certainly time that something of the nature of an international colour scheme be adopted, so that there should be no difficulty in referring to a definite scale and number in describing any colour.

A. P. Laurie.

DIET AND DEVELOPMENT.[1]

THE main impression left by a perusal of this exhaustive report upon the diets of labour convicts in Bengal jails, referred to below, is that the Indian Government has been well served in this matter, and has now in its possession advice derived so judiciously from soundly organised and ably conducted investigations as to justify what, on weaker evidence, might have seemed a parsimonious procedure, namely, some limitation of the too ample dietaries of these prisoners. The author may be said to have proved that their vegetarian diet, such as is the common food of the native population, has been provided in quantity so large as to escape digestion. No one will find reason to doubt his statement that this undigested material gives occasion to various forms of distressing trouble whilst in disordered transit through the alimentary canal of its consumers; not that this point is new, but that the condition has been very definitely shown as existing in this special and important case.

It would seem that, prior to this investigation, the diets had been arranged so as apparently to display the same "protein value" as a European diet. In the effort of imitating the heavy labour diet of English prisons with combinations of the native food-stuffs, meals of extraordinary bulk have been provided. Whereas, when added in small quantity to the varied constituents of a European meal, similar food-stuffs may yield so much as 80 per cent. of their contained protein for absorption into the tissues of the body, the author has shown that often no more than 50 per cent. is absorbed from them when found as the main constituents of a bulky meal, and this notwithstanding the fact that bulky meals are characteristic of the district, if to a somewhat smaller degree than within its jails. He has also proved that a certain ascertained diminution in this bulk, accompanied by an apparent diminution in the protein value of the diet, is always the

[1] "Investigations on Bengal Jail Dietaries, with Some Observations on the Influence of Dietary on the Physical Development and Well-being of the People of Bengal." By Capt. D. McCay, I.M.S. Pp. iv+226+15 charts. (Calcutta: Government Printing Office, 1910.) Price Rs. 2.6 on 4s. 3d.
(Scientific Memoirs by Officers of the Medical and Sanitary Department of the Government of India, New Series, No. 37.)

cause of an actual increase in the amount of protein absorbed, and has shown that some improvement in condition attends this alteration. His work promises, therefore, to be in a very real sense of economical value to the Government, indicating a better maintenance of health on wisely diminished rations. This statement also applies to his study of the salt requirements of these diets, which lead him to the conclusion that more salt is supplied than is useful, and that the excess is detrimental.

The author has carefully studied changes following an increased absorption of protein from the diet, and presents an admirable case for discussion alongside the valued contributions of Chittenden. He has enlarged his presentation of this case by reference to the habits of the different native races within his view. According to him, these races may be arranged in a series, in which virile characteristics vary directly with the protein value of the diet, and are greatest where, as amongst flesh-eaters, this value is at a maximum. Carnivorous man sets to his work with zest, and is prepared to labour strenuously, and, if need arise, fight for life. The vegetarian spends a gloomy existence, embarrassed by an internal tangle of cellulose, and is swept off by feebly resisted disease. Some of the evidence offered in support of this contention is not of the same value as that in the remainder of the report, but it is highly interesting, and has been usefully published.

Prof. McCay is to be congratulated upon a report that should be found in every library of physiological literature. The opportunities provided by such a systematic observation of human beings under very precise control are great, and have been well utilised.

J. S. MACDONALD.

RECENT PROGRESS IN AËRONAUTICS.[1]

THE sudden development of the art of flying which has come upon the world during the last few years may be classed as one of the most extraordinary events in the world's history. We have had far-reaching inventions introduced before, such as the railway, the telegraph, the telephone, the motor-car, and many others, but all these have gradually developed, have sprung from small beginnings, and often it seemed doubtful whether they would ever develop into utility of real importance. With the flying machine it is different. True it is that the advent of such an apparatus has been foreseen, not merely for some years, but for centuries. The inception is very old. Like the sailor's story to his incredulous grandmother of the flying-fish, so a hundred years ago no one would have been dumbfounded if one had prophesied that men would fly, although one would have been accused of talking nonsense had one foretold that we could talk along a wire hundreds of miles long, see bullets embedded in the lungs, or be able to reproduce a song sung by one departed. We dare not at present hazard a guess as to what the flying-machine may eventually develop into. There are still those who think it will never be much more than a curiosity, but there are others who believe it will soon become our usual mode of travel, and that railways, steamboats, and motor-cars will have to take quite a back place in comparison.

My object to-night is not to give a full history of the navigation of the air. That is getting into a big subject that would occupy a long time to properly relate. Nor is this to be a very technical lecture; I propose now merely to refer to the latest developments—to trace some lines of thought which I hope may serve as a basis on which my hearers may build more solid structures for the improvement of the navigation of the air.

Aërial machines have been classed under two headings, known as lighter-than-air and heavier-than-air. I do not purpose going very deeply into the question of the first class, because I am inclined to think it is a subject of comparatively little importance, the latter having made such very much greater progress of late, and being able to effect almost all that the dirigible is designed to do and with greater ease and efficiency, that it seems likely to entirely oust the former.

A few words, however, on gas-borne vessels may be desirable to point out how they have been evolved, and in which direction improvements may be looked for, should their development be considered advantageous.

Balloons.

First we have to consider that simple contrivance the balloon, by means of which men have, for the last century and a quarter, been able to rise in the atmosphere and drift with the wind wheresoever it listeth. It is a remarkable fact that, notwithstanding the great hopes it raised in early days, scarcely any improvement has been made in this contrivance during a hundred years of practice. This refers to the simple balloon. Almost immediately after its invention suggestions were made to form it as a long vessel and propel it with screws, and though to-day we have the practicable dirigible balloon, it is probable that no invention has been longer in developing. Step by step it has grown from the ideas of Meusnier, through the crude machines of Giffard, de Lôme, Tissandier, to the first successful vessel, that designed by Colonel Renard, nearly thirty years ago. Though much progress has been made since, it has always been slow.

Santos Dumont evoked much public interest with his little vessels; Count Zeppelin certainly made a big step forward with his large rigid-framed leviathans, while Parseval, Gross, Julliot, and others have further developed the invention. From Giffard's steam engine of 3 horse-power to the 500-horse motor of the Siemens-Schuckert, every variety of engine has been tried, continually increasing in power.

Nor does it appear that any very revolutionary advancement is likely to be effected in the future with dirigibles. We may hope to go on making each vessel a little better than the last, much in the way in which steamships have progressed.

Undoubtedly the main path along which improvement is possible and desirable is that of speed. So long as an aërial machine is only able to progress at a rate not much above that at which the wind usually blows, it is bound to be very dependent on the ever changeful weather. A dirigible can never be considered really practical (in this country at least) until it is capable of travelling at, say, 40 miles an hour. This is a speed not yet attained by any dirigible. The wind at one or two thousand feet up frequently blows at 30 miles an hour, and not only must we be able to make head against this, but we ought to be able to progress fully 10 to 20 miles in the teeth of it. Now, considering for the moment solely the lighter-than-air machine, given a certain weight of engines, since buoyancy is dependent on displacement, we cannot make the vessel any smaller if it is to lift the weight. In order to increase its speed, then, presuming the shape and the surface and fittings to be such as to offer a minimum of resistance, there seem but two possible means. One is to make engines more powerful for their weight, and progress in this line seems moving rapidly. The other is to increase the size of the gas-holder. As the volume is enlarged the lifting power (and hence ability to carry more powerful engines) is increased at a greater rate than is the cross-section and surface, and consequent resistance. So we get the tendency to construct huge machines ever growing larger. This size, however, is one of the greatest practical drawbacks to the employment of such vessels. It is true there is plenty of room in the sky, and if the machines had to remain always aloft there might be no difficulty. But to be of use they must come to earth, and the enormous bulk has to be held stationary against any wind that may happen to blow. This is exceedingly difficult, and necessitates the use of sheltered harbours and sheds to house these monstrous structures, which implies vast expense.

There is, however, yet another means by which it may be possible to increase the speed without adding to the bulk. It is one that has often been suggested, several times tried on a large scale, but does not seem to show signs of general application. I refer to the use of horizontally disposed surfaces known as aëroplanes. If we have an apparatus travelling at, say, 30 miles an hour, and we add such devices, it will be found that they give a very considerable extra lift, and this may be utilised for raising an extra weight of engines. By adding to the propulsive power we both increase the speed, and thereby

[1] Paper read before the Junior Institution of Engineers on April 11, by Major B. Baden-Powell.

the lift, which enables us to carry still further weight of engines, and so *ad infinitum*. This soon leads us on into another kind of appliance, for if we then want to increase our speed further, all we have to do is to reduce the resistance. This can now easily be done by lessening the size of the gasholder. Having thus gained more speed and got more lift out of our aëroplanes, we can still further curtail the volume, and so we go on until we find we have no gas left, and yet our machine progresses at a greater rate than ever! Therefore, why start with the troublesome gas bag at all!

Aëroplanes.

Six years ago such a thing as a real flying machine was unheard of. We had seen Maxim's great structure running along its rail. We had rumours of Ader having done something in secret in France. We had read of Langley's steam-driven model going for three-quarters of a mile. But it was in 1905 that accounts began to leak out of real flights having been accomplished by the Brothers Wright in America. In the following year Santos Dumont gave the first public demonstrations of a man being lifted off the ground by such an apparatus. In 1907 Farman made a number of short flights up to about half a mile; Blériot and Esnault-Pelterie also made some "hops." It was not until 1908, however, that anything approaching real flight was shown to the world, when Henry Farman and Delagrange accomplished what was considered extraordinary performances on a Voisin machine, and when later in that year Wilbur Wright set up his machine in France, while his brother Orville flew (with such unfortunate results) in America; the introduction of practical flight may then be said to have come about.

In order to realise the great progress in the art of flying from that period to now, some two years and a half, I may quote the "records" accomplished:—

	Duration in the air. Hrs. Mins.	Distance travelled. Miles.	Altitude attained. Feet.	Speed Miles per hour.
1905	0 36	24	—	40
1906	—	$\frac{1}{4}$	—	25·8
1907	0 $\frac{3}{4}$	$\frac{1}{2}$	19	33·7
1908	2 20	$77\frac{1}{2}$	328	40·5
1909	4 17	145	1,560	48
1910	8 12	365	10,500	65·5

During 1909 much progress was made. In England, Cody made some creditable flights; in America, Glenn Curtis, McCurdy, and others; while in France quite a number of aviators budded forth. In 1910 all records were beaten out and out, and very much was accomplished.

It is thus evident that immense progress has been accomplished in flying. Now let us turn to the machine itself and see in what essentials it has been improved. A vast variety of machines have been built and even tried, but of those differing much from what we may call the standard types, very few have accomplished any success.

I take as the standard types the Wright (with large elevators and no tail), the Farman or Voisin (with small elevator and big tail), and the Blériot monoplane (with no elevator in front, but tail behind); most other machines are but modifications of them.

Wright Type.—The original Wright machine has undergone three important modifications, which render the latest pattern a completely distinct type from the first machine. First, wheels have been applied, so that it is now capable of rising directly off the ground after a preliminary run, and is not dependent, as it originally was, on being drawn along a rail by falling weights, so as to give it an initial impulse. Secondly, a horizontal tail has been added, which has greatly improved the inherent fore and aft stability. Finally, the front biplane elevator, which seemed so essential a feature, has been done away with. A machine of smaller area has also been produced, the span being only 22 feet, or nearly half the dimensions of the original machine. It is now reported that the Wrights are building a machine to carry eight people in a closed carriage, with a 100 horse-power motor.

The Cody biplane is very similar in general design to the original Wright, at first having no tail (though one has been added recently), the main difference being that it has only a single propeller, and has ailerons placed between the planes at the outer ends to effect the same as the warping of the Wright planes. The details of arrangement of the frame and wheels are somewhat different, and the elevator in front consists of two independent planes side by side. It is a large machine, having a span of $46\frac{1}{2}$ feet, and the upper planes being $8\frac{1}{2}$ feet above the lower.

Voisin and Farman.—To follow up the development of the Henry Farman and Voisin types, the two must be taken together, since the former was but a modification of the latter.

The first successful Voisin machine consisted of a biplane divided into "cells" by vertical walls. The span was about 34 feet. It had one biplane elevator and a very large cellular tail. The latter was soon reduced in size to a span of 8 feet.

The Henry Farman biplane, which was evolved from the Voisin type, the main difference being the omission of vertical planes and the addition of flaps for transverse control, has not altered very materially. The size of the box tail has gradually been reduced, and in the latest machines the upper plane is made wider than the lower by the addition of extensions. Both H. Farman and Grahame White have recently tried machines of much smaller area. The former has planes of 150 square feet each, and has lifted at the rate of $6\frac{1}{2}$ lb. per square foot. There are a number of other machines of similar build. The Curtiss differs in having ailerons instead of flaps, and the Maurice Farman, the Sommer, the Bristol, and the Howard Wright differ only in small details.

Blériot.—The Blériot monoplane, which underwent a great variety of modifications to start with, has now settled down into the well-known type with a span of about 30 feet, with a fixed tail behind fitted with inclinable planes on each end. The latest type of two-seater is of 36-foot span, with a trailing flap tail.

The *Antoinette* monoplane is not very different in its general characteristics. It is much larger, and the "aspect ratio" or plan of the wings shows a greater span for length. Flaps are attached to the trail of the outer ends of the planes, and a fixed horizontal tail, or "empennage," is arranged at the end of the body.

Santos Dumont's *Demoiselle* monoplane is much the same type as the Blériot, but has always been of smaller size. Other features are that the man is underneath, and the engine is placed on top of the planes, so as to raise the centre of gravity, which would otherwise be very low, and to be able to couple the $6\frac{1}{2}$-feet diameter propeller direct to the shaft.

Other Types.—Other types of successful machines include the Breguet, which, though a biplane, has all the other characteristics of a monoplane, viz. propeller in front of all, with the engine behind it, fish-shaped body, and cruciform tail behind. This has proved very satisfactory, having recently taken up as many as twelve people. A new pattern of Bristol is of similar design.

The Dunne biplane and monoplane, with redan-shaped planes and no elevator or tail, for which a large degree of automatic stability is claimed, have achieved considerable success.

The *Valkyrie* monoplane, which may be considered as a separate type, having its elevator, as well as a small fixed plane, in front, and the propeller behind the main planes, has also done well.

Taking a general view of the recent developments, we are confronted with strange anomalies. Some inventors, such as the Wrights, have discarded the front elevator, though this does not seem to prove it undesirable, for others have adopted it. While some Farmans have been improved by the addition of more surface, yet small machines of nearly half the area have proved highly satisfactory.

One of the most surprising results of a study of these changes in design is that it seems possible to alter the disposition of the surfaces of a machine in quite a marked manner, and yet there is but little difference apparent in the ability to fly. It becomes very puzzling to the mathematician and theorist who wishes to investigate the subject, and to ascertain the whys and wherefores, when he reads of areas being reduced without detriment, of eight and even twelve men being carried on a machine designed

to carry only one or two, of a machine fitted with a 50 horse-power engine flying faster than one almost exactly similar having a 100 horse-power engine. It all seems to show how very little we know of the principles which underlie the matter, and how much really careful experiment and research are needed if we are to go by anything more than rule of thumb.

Now that a certain amount of experience has been gained, we can get at some idea as to which type of machine is generally pronounced the most satisfactory. It is perhaps curious that two types so different as the Farman biplane and the Blériot monoplane have performed so similarly, and there does not seem to be any decided preference among flying men between the two. The following figures of the machines on which certificates had been gained in France last year give some idea of the popularity:—

93 Blériot monoplane, 81 H. Farman biplane, 37 Antoinette monoplane, 30 Sommer biplane, 26 Voisin biplane, 16 Wright biplane, 15 Hanriot monoplane, 9 M. Farman biplane, 20 on other biplanes, 17 on other monoplanes (besides 10 others not specified), that is, 162 monoplanes and 182 biplanes.

Of British-owned machines, according to Jane's "All the World's Airships," there are (or *were* five months ago):—

34 Blériot, 14 H. Farman, 6 Voisin, 8 Wright's, 5 Sommer, 4 Antoinette, 1 Demoiselle (besides small numbers of various English makes).

This list is, however, not very trustworthy as an indication, as many of these machines have scarcely been tried, and many others (not included) have done good service during the last four or five months.

Automatic Stability.—A great deal has been said and written on this subject. Before practical flight had been attained, it was often thought that it would be necessary to apply some controlling mechanism actuated by a pendulum or gyroscope, so that when the machine tilted over it would be automatically forced back. Practice has shown that such an arrangement is quite unnecessary. We still hear of projects of this nature, but it is evident, not only from the performances of actual machines in the hands of expert aviators, but also from uncontrolled models, that a properly designed and properly balanced machine is quite stable by itself.

Motors.—The subject of motors for aërial work is perhaps rather beyond the scope of this paper, but since so much depends upon the motive power—indeed, the advent of the successful aëroplane may be said to have been entirely due to the invention of the petrol engine—I must refer briefly to it.

The chief notable feature in this line is the very general adoption of the Gnome rotary motor. This peculiar engine, which, of course, consists of seven cylinders radiating from a central shaft, which spin round forming a fly-wheel, and very efficiently cooling themselves by their rapid motion through the air, was at first looked upon as an impracticable freak. In 1909, however, it was fitted to several machines, and at once proved itself trustworthy and superior to all other motors for the purpose. Recently quite a number of engines of somewhat similar design have been brought out, and some of them, such as the Buckman, seem likely to prove even more efficient.

Meanwhile, several British-built engines of more ordinary design have come to the fore, notably the Green, with four water-cooled vertical cylinders, the N.E.C., a two-stroke motor, and the E.N.V., and several others, but for one reason or another these do not seem to be so popular with practical aviators.

Future Developments.—It is, of course, extremely difficult to foresee in which direction aëroplanes are likely to develop. There is, however, here again one of those what I may call "reciprocal" situations such as I have referred to with regard to balloons. The tendency seems to be to make the planes smaller. By this decrease the weight is lessened as well as the resistance. By lessening the resistance the machine should travel farther, and the decrease of weight of planes should enable a heavier and more powerful engine to be carried, and thus speed again increased. By travelling faster we obtain more lift, and can therefore further cut down the size of the planes. So we go on, making the machines smaller and the speed faster; and who can say where the limit may be?

Other types of machines have often been suggested, notably those of the wing-flapping species, and those with vertically acting screws. Seeing the success which has attended the simple aëroplane, I think it is doubtful if any other form will supersede it, but I have long been of opinion that some combination may prove advantageous. For instance, it is possible to arrange for vertically thrusting screws to assist in starting the machine, and it seems quite probable that a propeller on the flapping-wing principle may prove highly efficient.

THE AUSTRALASIAN ANTARCTIC EXPEDITION.[1]

AUSTRALIA and New Zealand have always been anxious for further knowledge of the great frozen continent lying to the southward of them. Because the Ross sea area is more conveniently situated to the south geographic pole, most expeditions to the Australian quadrant have wintered there. This has led to the neglect of the great coast-line westward of Cape Adare. Our information regarding it is very fragmentary, and for the most part untrustworthy. Properly equipped, an expedition to this region should have no difficulty in achieving great geographical successes. In the words of Dr. H. R. Mill, "It is time, at any rate, that someone should revisit the lands discovered by Biscoe, Balleny, D'Urville, and Wilkes. . . ."

Lying within wireless telegraphic distance of our borders, this region has a special call upon Australians. Alive to the value of scientific data there massed waiting to be collected, I have ardently sought for an opportunity to reap the harvest. Captain Scott's programme was too full with the determined efforts in view, upon the south geographical pole and King Edward VII. Land, to accede to my request to be landed this year with a party at Cape Adare. It was then that Sir Ernest Shackleton proposed to raise the necessary funds, and, with myself in charge of the scientific work, to attack the whole coast-line between Cape Adare and Gauss Berg. The plans were published in the Press on March 19, 1910, and repeated later in the year. Eventually Sir Ernest Shackleton handed over command to me.

Until the last fifteen years, though touched upon as early as 1820, only about seven expeditions, excepting whalers in the areas south of America, have come within sight of the continent. It was not until 1898 that the first Antarctic night had been experienced; even to the present day but four expeditions have wintered on the continent, and their contributions refer only to isolated spots of the 8000 miles, more or less, of coast-line. It is gratifying to note the successes which have attended recent assaults upon the unknown, and we can confidently look forward to the complete unravelling of the broader features and secrets of Antarctica within the next three years.

The Antarctic Continent.

Conclusions of any but local value based on the data available are obviously liable to prove in error, but will always serve a useful purpose in directing the attention of explorers to possible contingencies. The inadequacy of the data available is comprehended when we find, based upon them, several entirely different views regarding the geomorphology of the South Polar region. There is, nevertheless, a general agreement regarding the seaward limits of the land and the permanently attached ice. That is to say, we can now guess approximately the limits of southward navigation—where ships must be brought up either by land or barrier ice. Assuredly considerable portions of this coast-line are no more than barrier ice—marginal shelf-ice of great thickness—which in the recent past may have been of greater seaward extent, and in the future may retreat even hundreds of miles before the rocky coast-line is revealed. These barriers originated from the land glaciers, and are partly aground, partly afloat. It appears probable that the immense thickness of nearly 2000 feet is sometimes reached. In such cases the barrier ice, though afloat,

[1] From a paper read before the Royal Geographical Society, on April 10, by Dr. Douglas Mawson.

plays the *rôle* of land, and is charted as the margin of the continent.

Concerning the topography of the interior, all is speculation except in the vicinity of Captain Scott's and Sir Ernest Shackleton's exploits.

Thus it is that some hold the view of a continuous high land from Graham's Land to South Victoria Land—a continuation of the Andean chain; others regard the possibility of a great trough-subsidence, continuous from the Ross sea to the Weddell sea, isolating an eastern and a western Antarctica. Yet another view is that Enderby Land is part of a third isolated mass. There are many grounds in support of the existence of a trough between the Victoria Land massif and the Andean continuation of Graham's Land. Granted its existence, it will be still uncertain whether this depression sinks below sea-level, or is merely a topographical feature of the land. The existence of a passage below sea-level appears quite unlikely to me. Nordenskjöld and Gunnar Anderson have shown how the highlands of Graham's Land must be regarded as a continuation of the Andes. Possibly, further to the westward, this folding has been responsible for land trending towards King Edward VII. Land, the presence of which has been inferred by Charcot, and does not participate in the piling up of the mighty ranges which girdle the south geographic pole.

This may ultimately prove to be correct, for the geology of Victoria Land corresponds with that of Australia and Tasmania, whilst, in the same region, Andean types are represented further to the eastward amongst the Pacific islands.

Another point of correspondence is that South Victoria Land is elevated *en bloc*, and not subject to the contortions of folding illustrated in the Andes. I am not by any means the first to entertain this idea of an inverted South America. According to it, the highlands of Graham's Land are continuous with the mountain ranges of South Victoria Land. To the westward of this main range there is a great plateau, in part as much as about 10,000 feet in height, eventually sloping to the Indian and Atlantic oceans. Eastwards, on the Pacific side of the range, there is a precipitous scarp. We have no means, as yet, of telling whether this lower area is barrier ice with occasional islands, or is extensive undulating land.

Between Gauss Berg and Graham's Land, on the Atlantic ocean side, it is likely that most of the sea-front will be occupied by barrier ice; Enderby and Kemp lands, therefore, may be no more than islands.

The consanguinity of the lavas of Gauss Berg and the Ross sea downthrow area is suggestive of a similar downthrow in the direction of the former; it is possible, therefore, that a considerable indentation lies west of Gauss Berg.

According to present views, the Antarctic continent has an area of about five million square miles, the major part of which is a plateau of great height. Geographers are generally agreed, at any rate, that the main land mass of the Antarctic regions lies in the Australian Quadrant. This has been independently arrived at from theoretical considerations by Mr. E. A. Reeves, who has discussed the subject of distribution of land and sea as judged by the deflection of the lines of magnetic force.

Glimpses only of the past history of Antarctica are yet known—fragments gleaned from the analysis of scientific data to hand. We know that there were periods when ice was almost unknown, when great formations of water-deposited beds accumulated, associated with coal-bearing strata; these beds have their exact prototypes in Tasmania—in fact, where Tasmania leaves off South Victoria Land begins. We believe that in not long geologically remote times the intervening 1500 miles became engulfed; this conclusion is arrived at by an entirely separate line of argument proceeding from the evidence supplied by fossil and living forms of life.

Australian and New Zealand types show a remarkable affinity with those of South America and South Africa. This striking similarity in variety and range is exemplified not only in the bird life and mammalia, but also in the crustacea, amphipoda, mollusca, galaxias, and others. The similarity extends to the flora also. To the casual observer the connection is most noticeable in regard to the birds and mammals. We find parrots and struthius birds of the ostrich type common in these southern lands. Considering the marsupial mammalia, such occur at the present day in the Australian region and in Central and South America. Of the two sub-orders, Polyprotodontia and Diprotodontia, into which the marsupialia are divided, the Diprotodontia, which are the more primitive, are essentially Australian, as shown by the abundance of their fossil remains. The fact, however, that a representative of this class is now living in South America is strong evidence of a land connection, unless an independent and convergent process of evolution is regarded as possible. Further, the fossil evidence is absolutely in favour of a continuity between South America and Australia—as, for instance, may be mentioned amongst the extinct marsupial fauna of Patagonia, the Prothylacinus, which is essentially identical with the Tasmanian tiger. All this evidence confirms the theory of connection between the southern lands by way of Antarctica.

On the other hand, there is no line of argument founded on fact which can be urged to support the view of immigration by way of Asia. Suppose, for instance, that the marsupial fauna had come to Australia from Asia; then we should expect to find the types most numerous and most generalised in Northern Australia and Asia. Identically opposite is the case, and in the whole of Asia no living or fossil marsupial has ever been found.

The evidence is conclusive, therefore, in the minds of men of science, that in the not long (geologically) past there existed a habitable Antarctic continent with rays stretching up to meet with what are now Tasmania, South America, New Zealand, and South Africa. With regard to the relative dates at which these countries became severed from the southern continent, the evidence shows that with South Africa was the earliest and loosest. New Zealand, though possessing many of the features of Antarctic flora and fauna, never received a marsupial population, and its final separation is thereby allocated to the early Tertiary times. Australia, then separated by the formation of Bass strait, and more recently Tasmania and South America, have become isolated by the engulfment, due to diastrophism of the land bridges connecting both with the Antarctic continent.

Much of the strata of Southern Australia are composed of the *débris* of this lost land. To the south of Australia, where now is ocean, were highlands, providing an abundance of material shed northward into what were then lowlands and marine areas. Volcanic activity on a large scale, remaining even to the present day in isolated spots, attended the separation of these land masses. Finally, an ice age of almost unprecedented severity overwhelmed the residual Antarctic continent, and swept every trace of life into the southern ocean.

The Plans of the Australian Expedition.

We hope to have a complement of fifty men—ship and land party—and proceed south from Australia about the close of this year. Practically every member of the land party will be a specialist in a particular branch of science. Most of the recruiting will be amongst the graduates of the universities of Australia and New Zealand.

It is our intention to land several parties with stores and huts, to winter between Cape Adare and Gauss Berg, and the ship will return to Australia and New Zealand for the winter, though not remaining idle. It had been our intention of dropping a few men at Cape Adare, for that is the easiest and most accessible landing on the Antarctic continent. The facilities there afforded of coal and stores left by Borchgrevinck's expedition would have further simplified matters. In the light of recent events, of course this must be eliminated from our programme. It is our special desire to accomplish a complete coast survey between the two points mentioned, and complete the magnetic charting of the region north of the south magnetic pole. The several wintering stations will simultaneously despatch coastal sledging parties on either hand, thus dividing up the task. A special journey will be made inland from our main base on the north coast to the south magnetic pole, thus completing, in conjunction with the former journey in which I participated, the crossing of that corner of South Victoria Land. For the rest, without entering into details, I may say that no branch of science will be neglected.

Before Australian meteorology is placed on a final basis—before the causes are known which produce the effects

observed—much more requires to be known regarding the circulation of the atmosphere in high southern latitudes. There are no other portions of our globe, excepting equatorial regions themselves, which influence so greatly the climate of the southern hemisphere than the Antarctic continent. It is a vast refrigerator condensing warm moist overhead currents from the equator and speeding them back at sea-level, frequently with hurricane velocity, much to the consternation of Australian shipping. All such irregularities in the regular anticyclonic cycle can be predicted by an observing station on the coast of Antarctica, southward of Australia. That the regular phases of barometric pressure in the Antarctic regions are the dominating causes that affect the climates of the southern temperate regions cannot be denied, and by their study we shall become more capable of predicting weather for Australia.

It is very desirable that a permanent meteorological station in connection with Australia and New Zealand be erected either at Adelie Land or to the west of it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—As an outcome of the recent increase in rate aid granted by the City Council, the University has drawn up a scheme for bringing facilities for higher education within the reach of the poorest scholars who may have the requisite ability. Twelve entrance scholarships, tenable for four years, are offered for competition at the forthcoming matriculation and intermediate examinations in July and June respectively. Candidates must have been resident within the city boundaries for at least one year, and must have attended one of the schools in that area. Competitors must reach such a standard as, in the opinion of the University, offers a reasonable prospect of a successful or distinguished career. Competitors may further apply for an annual grant (not exceeding 30*l.*) towards maintenance, on the ground that they are unable to avail themselves of such scholarships without a maintenance grant in addition. It will be interesting to see to what extent the maintenance grants increase the number of suitable candidates, for hitherto the number of entrance scholarships has been in excess of the number of properly qualified applicants.

It is officially announced that Dr. Theobald Smith will be the Harvard exchange professor at Berlin University during the academic year of 1911–12. Dr. Smith has held in succession the chairs of applied zoology and comparative pathology at Harvard, and is a member of the board of directors of the Rockefeller Institute for Medical Research.

The Council of the City and Guilds of London Institute has elected Dr. E. Frankland Armstrong a fellow of the institute (F.C.G.I.), in recognition of his original research work and his contribution to the advancement of the industry, in which he has been engaged since he gained the associateship of the institute at the close of his regular course at the City and Guilds Central Technical College in 1903.

The University Extension Board of the University of London has arranged a training course for lecturers to be delivered in the University buildings, South Kensington, in the Easter term. The course will consist of four lectures by Prof. John Adams on "The Art of Lecturing," four lectures by Dr. H. H. Hulbert on "The Delivery of Lectures," and six meetings for practical work. Each member of the class will have an opportunity of delivering a trial lecture, and will have the advantage of the criticism of Prof. Adams as regards material and arrangement, and by Dr. Hulbert as regards delivery.

SOCIETIES AND ACADEMIES.

London.

Royal Society April 6.—Sir Archibald Geikie, K.C.B., president, in the chair.—Hon. R. J. **Strutt**: The Bakerian lecture. A chemically active modification of nitrogen produced by the electric discharge. The leading facts established are:—(1) That pure nitrogen, from whatever source, subjected at a low pressure to the jar discharge, undergoes some modification which causes it to glow for a short time after it has been sucked away from the discharge. (2) The glow which is emitted while the gas returns to its normal condition is not destroyed by the removal of ions. It is weakened by heating, intensified by cooling. This seems to favour the view that it is due to the recombination of dissociated atoms. (3) The modified nitrogen acts on ordinary phosphorus, combining with it, and at the same time forming much red phosphorus. (4) It combines with sodium and also with mercury at a gentle heat (say 150° C.), forming in the latter case an explosive compound, and in each case developing the line spectrum of the metal concerned. It also develops the line spectra of other metals, probably combining with them. (5) It develops the band spectra of compounds, when these are vaporised in it, giving in many cases spectra of substances too unstable to be examined at the temperature of the Bunsen flame. (6) It attacks acetylene, and substances like ethyl iodide or chloroform, setting the halogen free when there is one, and combining with the carbon to form cyanogen. This is proved by the brilliant cyanogen spectrum produced, and by direct chemical tests, such as formation of Prussian blue. (7) It attacks nitric oxide, with formation, strangely enough, of nitrogen peroxide, a more oxidised substance.—A. **Holmes**: The association of lead with uranium in rock-minerals, and its application to the measurement of geological time.—Prof. E. T. **Whittaker**: The dynamical value of the molecular systems which emit spectra of the banded type. It is now widely believed that when the spectrum emitted by a luminous body is of the banded type, the small vibrators which give rise to the radiation are the molecules of the substance, as distinguished from atoms or ions. This result is applied in the main body of the paper in order to suggest a dynamical system, which is formed of two members in the same way as a diatomic molecule may be supposed to be formed of two atoms, and which has free periods of vibration related to each other by the same formula as holds in the case of banded spectra. This formula presents a certain peculiarity, in that the frequency of vibration occurs in it linearly, whereas in the equation for determining the free periods of dynamical systems in general the frequency enters by its square. It is shown that from this peculiarity in the radiation of a molecule certain inferences may be drawn regarding the dynamical character of the connection between the atoms within the molecule. It is shown that a somewhat modified mechanism would emit radiations connected by the same law as that which Balmer found for the hydrogen lines.

Royal Meteorological Society, March 15.—Dr. H. N. Dickson, president, in the chair.—Prof. H. H. **Turner**: What can we learn from rainfall records? The "periodogram" method has been applied under the superintendence of Prof. Schuster and the lecturer to the rainfall records of Padua (175 years) and Greenwich (90 years), besides Klagenfurt and Oxford (50 years), all periods between 20 months and 5 months having been examined, as well as some others. The resulting indications are not very positive, but include several features well worth further study, especially in the Greenwich rainfall, where periodicities of 597 days and 150 days (possibly a quarter of the former) seem to be fairly persistent, as well as a short one of 25 days; but these are not reproduced in the Padua records, at any rate not exactly. There are doubtful periods of 591 days and 147 days, which again are possibly related by the ratio 4 to 1. (The shorter periods near 25 days have not been investigated, as daily records are required.) It is possible that the periodicities change slowly with the latitude, in a manner suggested by the cloud belts on Jupiter.

Geological Society, March 22.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: Some mammalian teeth from the Wealden of Hastings. Mr. Charles Dawson has obtained two imperfect molars, apparently of Plagiaulax, from beds of grit in the Wealden near Hastings, and his associates in the work of exploration, Messrs. P. Teilhard de Chardin and Félix Pelletier, have found a well-preserved multituberculate molar of the form named Dipriodon by Marsh. These specimens are described.—A. **Wade**: Some observations on the Eastern Desert of Egypt, with considerations bearing upon the

origin of the British Trias. Phenomena observed in the Eastern Desert of Egypt, bordering the Gulf of Suez, are described. The origin of the mounds of igneous débris which flank the coastal hill-ranges is discussed. The distances to which fragments of igneous rock derived from these hills have travelled in Egypt are shown. The shore-sands are dealt with, and their origin ascribed to the breaking down of local rocks. In the marly beds connected with the shore-deposits, tiny dolomite-rhombs, similar to those found by Dr. Cullis in the Keuper Marls, are present. Some effects of wind-blown sand are detailed. The alteration of the calcium carbonate in recent shell-beds to gypsum is noted, and its significance with regard to the origin of gypsum-beds is pointed out. The characters of the massive older gypsum- and rock-salt deposits are described, together with the distribution and lithological changes in the beds when traced across the area. The origin of the gypsum series is connected with inland salt-lake conditions, and the evidence suggests that these conditions were contemporaneous with the Oligocene continental period in Egypt, and with the formation of the beds of the Fayûm in the Western Desert.—H. **Bolton**: Faunal horizons in the Bristol coalfield. The existence of faunal horizons at the collieries in the Bristol and Gloucestershire area, and in the Radstock area, has been determined. A measured section has been examined in detail, and four faunal horizons discovered. In every case the fauna was marine in character, and the series are all characterised by a fauna agreeing with the typical fauna of the Lower Coal Measures of the coalfields of the Midlands, and of Lancashire and Yorkshire. Species of Carbonicola are rare, while the cephalopod and fish fauna is poor. The second series of the Upper Coal Measures has yielded *Lingula mytiloides*, several species of ostracods, four species of Anthracomya, and scales of *Strepsodus sauroides*. *Coelacanthus elegans* has been found in the first series. In the Bristol coalfield the marine fauna undergoes no marked change in its upward range. Insect-wings referred to the genus Genentomum have been found at one horizon, while the rare phyllopod, *Leaia leidyii*, var. *salteriana*, hitherto only known from the Lower Carboniferous of Fifeshire, was found in abundance. The total number of species now recorded from the Bristol coalfield amounts to seventy-four.

Mineralogical Society, March 21.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Prof. W. J. **Lewis**: Mr. Solly's observation of wiltshireite in 1903. Wiltshireite is identical with the mineral which Mr. Solly exhibited and described before the society, November 17, 1903, and subsequently named rathite α, but of which no complete description has yet been published.—R. H. **Solly**: Two new minerals from the Binnenthal, Switzerland. Both are probably sulpharsenites of lead, being lead-grey in colour and giving a chocolate-coloured streak; one, which is rhombohedral-diplohedral, and has an angle $111:100=38° 18'$, is probably isomorphous with trechmannite, while the other may be orthorhombic, the angle $100:110$ being $58° 18'$, but no measurable end faces were observed.—J. B. **Scrivenor**: Notes on cassiterite in the Malay Peninsula. Cassiterite from a mine at Gopeng contains ilmenite and magnetite, and is attracted by the magnet; it also occurs mixed with tourmaline pseudomorphic after an hexagonal mineral, probably quartz.—Arthur **Russell**: Notes on the occurrence of dundasite in Derbyshire and co. Galway, and of bertrandite in Cornwall. Dundasite was discovered at Mill Close mine, Wensley, Derbyshire, as snow-white spheres associated with greenockite, fluor, cerussite, calamine, &c., and at Clements lead mine, Carrowgarriff, near Maam, co. Galway, associated with allophane and cerussite, and bertrandite was found in platy crystals on old specimens of blende from Wheal Vor, Breage, Cornwall, and as trillings, measuring up to 4 mm. in length, on a specimen from Wheal Metal, Breage, Cornwall, which had been presented as albite to the British Museum in 1870; in the latter case the crystals were similar to those from Pisek, Bohemia, described by C. Vrba.—Dr. J. **Drugman**: Quartz-twinning. The possible varieties of twinning of quartz were discussed, with special reference to the rhombohedron type, a specimen of which was exhibited.—T. V. **Barker**: Crystallographic notes. Two new forms found on crystals of inosite confirm the hypohexagonal type of symmetry suggested by Fedorow. The rhombohedral modification of potassium nitrate, unlike sodium nitrate, does not arrange itself regularly when deposited on a cleavage piece of calcite; the crystals are very unstable, and rapidly pass into the ordinary orthorhombic form. A parallel growth of calcium chromate on the isomorphous mineral gypsum was obtained. New forms have been observed on urea nitrate which enabled the axial ratio $b:c$ for the first time to be calculated; the crystals have large birefringence, and, when grown in a drop, are nearly always twinned.

Physical Society, March 24.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. H. F. **Haworth**: (1) A sensitive thermo-regulator; (2) experiments on the measurement of electrolytic resistance using alternating currents. The "thermo-regulator" consists of a toluene thermometer with mercury platinum contacts in a capillary tube; these contacts operate, through a Siemens telegraph relay, an electromagnetic switch, which cuts in or out the heating circuit. On account of the very small current required to operate the relay, a fine capillary may be used, so ensuring a high magnification with low thermal capacity. Experiments were also shown illustrating the ease with which a bridge containing an electrolytic cell could be balanced by placing a variable self-induction in series with the cell and adjusting it and the resistance of the bridge simultaneously, as in Wien's experiments, except that a vibration galvanometer was used in place of the optical telephone originally employed by Wien. The author's deduction from his experiments was that the resistance of an electrolyte varies with the frequency of the alternating E.M.F. applied.—Prof. G. W. O. **Howe**: Oscillatory currents in coupled circuits. A demonstration was given by means of a double projection oscillograph of the currents in coupled oscillatory circuits. Each circuit consisted of a condenser, an air-core choking coil, and a strip of the oscillograph. The condenser in the primary circuit was charged and discharged by means of a commutator on the spindle of the oscillograph motor. The two circuits may be taken to represent the condenser circuit and the aërial of a wireless telegraph sending apparatus, the frequency being two or three hundred instead of a million. The currents in the two circuits can be studied, and every change due to a variation in the damping of either circuit or in the coupling between the two circuits can be followed. This was illustrated by a series of typical photographic records. A third oscillatory circuit may be taken to represent a wave-meter, and used to plot resonance curves, from which the damping can be calculated, as is commonly done in radio-telegraphic work. Here, however, we have the great advantage of knowing the damping accurately, and thus being able to check the resonance curve results under various conditions. By altering the connections, the conditions of the quenched spark sending apparatus, as used by Max Wien, Lepel, &c., was represented. Here the primary circuit is opened at the first moment that all the energy has been transferred to the secondary circuit, and no further beats or spark-gap losses occur. Results were given showing that the oscillograph can be used to find the losses in condensers at various frequencies by discharging the condensers through inductances of known resistance.—Prof. G. W. O. **Howe**: Some radio-telegraphic apparatus in use at the City and Guilds College. The wireless telegraphic receiving apparatus was shown connected up to the aërial, which is 260 feet high. A transformer specially designed for experimental work at long wave-lengths was shown. By means of a Brown telephone relay and special trumpets fitted to the telephone receiver, the time signals and messages sent out from Norddeich and from the Eiffel Tower can be plainly heard anywhere in the lecture theatre. The various types of receiving apparatus in use at the college were shown.

Zoological Society, April 4.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham** and Dr. Annie **Porter**: Diseased bees and combs infected with a minute pathogenic protozoal parasite, apparently the same as *Nosema apis* found by Zander and Doflein in diseased bees in Bavaria. Microscopic preparations and drawings of the parasite, *N. apis*, were also shown, as

well as healthy bees and combs in contrast. The material was obtained from Cambridgeshire and Hertfordshire in March. The infected combs were brown in colour instead of the normal yellow, while the infected bees suffered from a sort of dry dysentery, which rapidly proved fatal. The pathogenic agent of this dry dystentery, *N. apis*, formed thousands of minute spores, which fouled the hive, while infection was probably spread to new hives by hungry, weakly bees attempting to enter healthy hives. The spores, about 2 to 3 μ by 4 to 6 μ, were the resistant and cross-infective stages of the protozoon. The parasite N. *apis* was closely allied to that of pébrine, the silkworm disease due to *N. bombycis*. The trophozoite and pansporoblast stages of *N. apis* had been observed, as well as some spores with polar filaments extruded. Like N. *bombycis*, the bee-parasite was possibly capable of hereditary infection, as infected bee-larvæ had been found. The only certain destructive agent of the microsporidian spores was fire, and all infected bees and hives, and any débris therefrom, should be most carefully burned. In the opinion of the exhibitors, the microsporidian parasite N. *apis* had been responsible for much of the bee-disease recorded in this country since 1906, especially in 1906, 1907, and 1911. The exhibitors first noticed the parasite in 1906 in diseased bees obtained from the Isle of Wight; its full significance was grasped in 1907, but owing to the difficulty of obtaining material the exhibitors' results were not published. As much attention was now being directed to "bee-disease," the exhibitors briefly recorded their observations. It was not asserted that microsporidiosis was the only disease of bees current in Great Britain at present, as Dr. Malden had investigated a bacillary infection in bees. Microsporidiosis had probably been introduced from the Continent into British apiaries.—Dr. R. T. **Leiper**: Nematode parasites obtained from animals in the Zoological Gardens during the year ending November, 1910. The collection contained a number of new forms, of which a systematic account will be published later. Among the more interesting of the known forms were *Rictularia plagiostoma* from a palm-civet, a number of species of Polydelphis from various pythons, *Dicheilomena horrida* from the South American ostrich, and *Dictyocaulus filaria* from the lungs of sheep. From the observations it appeared that the change of food and general conditions obtaining in the gardens were unfavourable to the continued existence of the intestinal parasites an animal may harbour on its admission. The number of cases of auto- and re-infection during captivity was strikingly small, and bore testimony to the cleanly surroundings in which the animals were kept. In four cases only was there evidence of the occurrence of accumulative infection in the gardens:—(1) a number of giant toads died from lung infection with *Rhabdias bufonis*; (2) the wolves appeared to be heavily infected with *Ascaris canis*; (3) a sheep died from pneumonic condition resulting from an intense infection with *Dictyocaulus filaria*; (4) the tortoises had oxyuriasis. In all these cases repeated infection undoubtedly had followed from contamination of food and drink with fæces containing eggs of the parasite. The infection could be eliminated by steam sterilisation of the cages, or still more easily by changing the species of animal living in the particular paddocks or cages, for helminthes were often peculiarly selective as regards their hosts, and those flourishing in one animal sometimes found it impossible to continue their life even in closely allied forms.—F. E. **Beddard**: Some mammalian tapeworms collected from animals which had died in the society's gardens. This collection was the result of nearly two years' examination of a very large number of animals, but did not contain a very large number of species. Tapeworms were by no means so common as other parasitic worms, particularly nematodes, which were the most abundant among the animals in the gardens.—. A. **Mörch**: The natural history of whalebone whales. The paper directed attention to, and threw light upon, some of the problems connected with the migrations of the larger Cetacea.

Linnean Society, April 6.—Dr. D. H. Scott, F.R.S., President, in the chair.—Miss Sarah M. **Baker**: The brown seaweeds of the salt-marsh.—Conjoint communication on the genus Salicornia. (1) Dr. C. E. **Moss**: A history of the genus from Linnæus, "Species Plantarum," ed. 1, 1753, to the present time; (2) E. G. **Salisbury**: An exposition of the characters of the species comprised in the genus; (3) Dr. Ethel **de Fraine**: The anatomy of certain species in the genus.

Paris.

Academy of Sciences, April 3.—M. Armand Gautier in the chair.—F. **Henneguy**: Experimental parthenogenesis in the Amphibia. The eggs of the frog (*Rana fusca*) were caused to develop parthenogenetically by simple puncture, following the method suggested by M. Bataillon. Comparison batches of eggs were impregnated in the ordinary way. Out of a large number of the punctured eggs, four only became normal tadpoles, and these were smaller than the tadpoles from the comparison batch.—**Albert I., Prince of Monaco**: The twelfth campaign of *Princesse Alice II.*—Sir J. J. Thomson was elected a correspondant for the section of physics in the place of H. Lorentz, elected foreign associate.—Th. **De Donder**: Jacobi's multiplier.—M. **Devaux-Charbonnel**: The direct measurement of diminution of loudness, and of the characteristic of telephone lines.—Victor **Henri** and Samuel **Lifchitz**: The kinematographical study of the displacements of ultra-microscopic particles produced by very rapid sound shocks. The action was shown to be a mechanical one, and to be independent of the electrical charge on the particles.—Paul **Lebeau**: The formula of uranium carbide. Analyses of some ingots of uranium containing carbon showed a percentage of the latter higher than would correspond with the Ur_2C_3 of Moissan. Castings were then prepared containing various proportions of uranium and carbon. Metallographic examination proved all of these to consist of a single carbide with varying amounts of graphite. It was found necessary to considerably modify the analytical method used by Moissan in the analyses of these compounds, and the true formula of the carbide was found to be UrC_2.—M. **Driot**: Mercury oxychlorides. Four oxychlorides, $HgCl_2.3HgO$, $HgCl_2.2HgO$, $HgCl_2.HgO$, and $2HgCl_2.HgO$, have been isolated, and each of these exists in one form only.—E. E. **Blaise** and L. **Picard**: The mode of formation of ethyl chloroethoxyacetate; the use of this ester in the synthesis of the α-acid alcohols. An attempt to prepare the chloride $(C_2H_5.O)_2CH.CO.Cl$ failed, a molecular transposition taking place, and the compound $C_2H_5.O.CHCl.CO_2C_2H_5$ being produced.—P. **Lemoult**: The new series of leuco-bases and colouring matters derived from diphenylethylene.—G. **André**: The conservation of the salt material in an annual plant: distribution of the fixed elements.—P. A. **Dangeard**: The conditions of chlorophyll assimilation in the Cyanophyceæ.—Jean **Bonnet**: Nuclear fusions without sexual character.—M. **Vermorel** and E. **Dantony**: The increase in the moistening power of anticryptogamic solutions for spraying.—E. **Kayser**: Researches on the juice of beer yeast.—L. **Bordas**: The intestinal cæcum and the rectal glands of the Lepidoptera.—P. **Chaussé**: Experimental tuberculosis in the dog. Under normal conditions, the latent mesenteric tuberculosis experimentally produced in the dog completely disappears from the system in 200 days.—L. **Cayeux**: The marine deposits resting on the middle Miocene in Crete.—Alphonse **Bergot**: The exact determination of the salinity of sea water by the measurement of the index of refraction. The refractometer was modified to read the index to 0·00001, and the relation between refractive index and concentration of salt was shown experimentally to be linear.

Cape Town.

Royal Society of South Africa, March 15.—Dr. H. H. W. Pearson, vice-president, in the chair.—Dr. Thos. **Muir**: Sylvester's and other unisignants. Unisignant is the name given to a peculiar class of multilinear functions which though expressible as determinants are quite unlike the latter functions in their properties, having, for example, in their final development nothing but positive terms. Probably the first instance of such a function was observed by Sylvester. The object of the present paper is to throw fresh light on Sylvester's work by bringing it into the same field of view with certain recent investigations of a mere

general character about to appear in *The Quarterly Journal of Mathematics*.—R. T. A. **Innes**: Upon the fourth order perturbations in the motions of Satellites III. and IV. of Jupiter. The author recomputes and practically confirms the values of certain long-period inequalities in the longitude of the third great satellite of Jupiter originally discovered by the late M. de Haerdtl. These inequalities are due to the near approach of commensurability of the mean motions of the III. and IV. satellites; seven times the mean motion of IV. being nearly equal to three times that of III, so that although these inequalities depend on the 4th powers of the eccentricities they exceed the limit of II. adopted in Prof. Sampson's "New Tables of the Great Satellites of Jupiter, 1910." The inequalities in the motion of IV. are now computed for the first time. In the sum these inequalities will at times amount to about 8" in the longitude of III. and 10" in that of IV.—C. L. **Biden**: The funeral ceremonies of the Hottentots. The Hottentots have their medical men who treat patients during illness. Like most South African tribes, witchcraft is practised by these medicine men, and the sick are told that their enemies, bad relatives, and bad neighbours are the cause of illness. In the event of death following, the medicine man attributes the disaster to the bad influence of certain parties, actually naming the persons he thinks concerned. Formerly these responsible persons were put to death; now it leads to much hatred and personal feeling among the Hottentots. Immediately after death they prepare for the funeral. A grave is dug by means of a gemsbok horn and a roughly made wooden shovel. The ceremonial is then described. After the funeral a dance is held, and festivities are indulged in all through the night. For a few weeks the male relatives of the deceased go to the grave every morning before sunrise, quite naked, and pray to the "taas" (ghost). After that time they suppose that the ghost has left the grave and has entered an animal called by them "thas" jackal. This animal they assert has never been caught, and it can only be killed by a silver bullet.—Prof. W. A. D. **Rudge**: The meteorites in the Bloemfontein Museum. The paper contains an account of the meteorites in the Bloemfontein Museum. There are two fragments of the Kroonstadt fall of 1877. These apparently consist of a tough fibrous mass of iron-nickel alloy, with an aggregation round it of fine particles of silica (asmanite?) troilite pyrites, and apparently felspar. The larger meteorite which fell at Winburg, 1881, contains 94 per cent. of iron and 2 per cent. of nickel. The nickel is confined to a few veins which run through the mass of the meteorite. From these veins crystals of the alloy can be separated by dilute sulphuric acid in which the alloy is insoluble. These crystals seem to be skeleton forms built up of triangular plates, the interstices being filled up with amorphous carbon. The iron is very soft, but patches of hardness occur. The "Widmanstatten" lines are not so well developed as in most iron meteorites, probably due to the nickel being located in veins instead of disseminated throughout the whole mass. The weight of this meteorite was about 50 kilogrammes, and it is markedly magnetic, having a number of poles. The alloy of nickel and iron retains its susceptibility up to a dull red heat.—J. R. **Sutton**: Seismographic record of the South African earthquake of October, 1910. The extent of the movement of the horizontal pendulum during the quake was about one-half its average daily E.W. oscillation.—James **Moir**: (1) Colloidal gold and purple of Cassius. Description of behaviour of chloroauric acid dissolved in 200,000 parts of water towards a number of reducing agents. The coloration produced by pure stannous chloride $SnCl_2$ is not purple of Cassius, but a brown of remarkable stability, which the author shows is not due to extreme fineness of division, and which may be colloidal aurous chloride. Purple of Cassius results when $SnCl_2$ and an oxidant with loosely bound oxygen are employed. The tin in the purple is shown to be merely a vehicle for finely divided gold, the shade varying from pink to indigo according to the rapidity of formation, the first division being obtained by the slow reducing action of glycerol. (2) Some remarkable oxidation products of benzidene. An investigation of the beautiful blue products obtained from benzidene by certain processes of oxidation, such as the blood-test. The products obtained by the action of chromic acid and of ferricyanide are shown to be the chromate and ferricyanide respectively of diphenoquinone-diamine $NH:C_6H_4:C_6H_4:NH$, but the latter is an extremely reactive substance and polymerises easily to very insoluble substances of the aminoazo-dye class. Benzidine is the sole reduction-product of the blue substances as freshly prepared. The violet azo-dye appears to be $NH_2.C_{12}H_8.N:N.C_{12}H_8.NH_2$.—H. W. **Tarbutt**: The Egyptian influence on Rhodesia ruin builders, or *vice versa*. The object of this note is to show that MacIver's statement that the Rhodesian ruins are of native origin does not seem too improbable, if the articles found in or about the Rhodesian ruins are compared with similar articles of Egyptian primitive art. The author contends that the very resemblance between them is not confined to one or two articles, but to almost everything that has been found, and illustrations comparing the Rhodesian and Egyptian objects are given to support the theory.

DIARY OF SOCIETIES.

WEDNESDAY, April 19.

Royal Meteorological Society, at 7.30.—Variations in the English Climate during the 30 years, 1881–1910: W. Marriott.—(1) The Value of the Two-theodolite Method for determining Vertical Air-motion. (2) An Automatic Valve for Pilot Balloons: Captain C. H. Ley.

CONTENTS.

THURSDAY, APRIL 20, 1911.

ENGINEERING ARTICLES IN THE ENCYCLOPÆDIA BRITANNICA.

Collection of Articles (loose sheets) dealing with Engineering, from the New (11th) Edition of the Encyclopaedia Britannica. (Cambridge: University Press, n.d.)

THE articles dealing with engineering subjects, in that portion of the new edition of the "Encyclopædia Britannica" which ranges from aëronautics up to irrigation, have been issued separately for the purposes of review. As a whole, the articles attain a high standard of excellence, and the writers are men of acknowledged authority. Some of these articles have appeared in previous editions, and are substantially reproduced; but they have been brought up to date in most cases. Many new subjects have been dealt with in an interesting manner, and the appended bibliographical references are generally of considerable value, and will guide in their choice of authorities readers who desire to obtain fuller information. As might be expected from the necessity for extra condensation existing in encyclopædic articles, there is a lack of due proportion on the part of some authors in treating individual branches of particular subjects.

The article on aëronautics has special interest at the present time, and deals fully with aërostation—the construction and behaviour of machines which are lighter than air. Aviation—the branch of aëronautics which is devoted to flying machines heavier than air, is treated very briefly under the heading of aëronautics, but is also discussed under "Flight and Flying." This subdivision is arbitrary, and from the engineering side it would be more convenient had flying machines of all kinds been grouped together.

The article on "Aqueducts" contains a comparatively brief account of modern practice, but ancient works and historical facts have been dealt with in considerable detail. It is notable also that while works connected with the water supply of Manchester and Liverpool are described at length, no reference is made to the later and equally important works carried out for Birmingham. The article on "Docks" is of great interest and value, giving good information as to most works of the kind; but it is strange to find only the briefest descriptions of modern floating dry-docks, although, as is well known, their development in recent years has been remarkable. Formerly graving docks were practically supreme; they have now become relatively less important, especially in foreign ports, where floating docks are to be found which are capable of lifting the largest ships.

Under the heading of "Canals" one would have expected to find fuller reference to the facts disclosed and suggestions made in connection with the recent inquiry by a Royal Commission into the present condition and use of British canals. The actual reference occupies only about a dozen lines, and looks like an afterthought. A few of the most important canal works of modern times are dealt with in separate articles, including the works at Panama and those incidental to the great enlargement of the Kiel-Brunsbuttel Canal, now being carried out by Germany, as a part of her naval strategy rather than with a view to any commercial benefits to her mercantile marine. In the treatment of certain subjects considerable latitude appears to have been permitted to writers, although the relative importance of these subjects hardly justifies the prominence given to them. In other cases there has been a degree of compression which is to be regretted. Editorial control of such technical matters is undoubtedly difficult, but it might in many cases have been exercised with advantage. The article on "Concrete," for example, deals with a subject of enormous and increasing importance, especially at a time when "ferro-concrete" construction—termed by the writer "steel-concrete"—is making rapid strides, yet its discussion—excellent so far as it goes—is compressed into five pages. On the other hand, the discussion of "Fire and Fire Extinction" occupies more than three times as much space. The latter subject is undoubtedly important, but from an engineering point of view it has not the relative importance which mere space measurement would suggest.

Apart from these criticisms on a few points of detail, it is a pleasure to record the opinion that on the whole the engineering articles constitute a valuable epitome of recent professional practice, and will be of great value for purposes of reference. Not a few of them are worthy of separate publication, the treatment displaying both thoroughness and ability. Some attain almost to the dignity of standard treatises on the subjects discussed, and amongst these may be mentioned the contributions of Dr. Unwin on "Bridges and Hydraulics," Mr. Dugald Clerk's article on "Gas Engines," Prof. Ewing's on "Air Engines," and Mr. Milton's on "Boilers." In many other articles modern practice is well described, and new departments of engineering are illustrated.

Special interest attaches to the articles on "Conveyors," "Elevators," and "Destructors," which deal with engineering appliances that are essential to the life and work of great centres of population. The paper dealing with "Divers and Diving apparatus" is admirable in its clearness and completeness, containing descriptions of recent improvements for working at great depths below the surface of the sea. Dredging is another subject which has been treated at length, and with great ability, both in relation to the construction and maintenance of channels and harbours, and its applications for purposes of scientific research. Diamond and gold mining are dealt with by high authorities in a manner which the general reader can understand. Coal and coal mining are equally well handled. A large number of shorter and less important articles are devoted to descriptions of engineering details and processes. Irrigation receives the attention it so well deserves, excellent accounts being given of the great and beneficial results obtained by British engineers in India, Egypt, and elsewhere, as well as the work done by foreign engineers in other countries.

A few short biographies are included in the

engineering section of the "Encyclopædia," although there is no clear indication of the principle on which the subjects have been selected. The biography of Sir Benjamin Baker is hardly worthy of the man. The article is very brief, and it gives no adequate idea of the great engineering works for which Baker was responsible. This is much to be regretted. On the other hand, the notices of Bessemer and Brassey (father of Lord Brassey) contain excellent summaries of widely differing careers. The description of the "swinging saloon" devised by Bessemer for cross-Channel steamers, and of the failure of that system in practice, illustrate the dangers attaching to ventures into new regions even when they are made by capable inventors who have achieved success in other directions. Bessemer had not mastered the principles of the behaviour of ships at sea, otherwise he would not have attempted to keep a swinging saloon level as the steamer rolled by the control of an attendant who watched the indications of a spirit-level, and manipulated hydraulic machinery. Thomas Brassey was not an engineer, but was simply one of the first and greatest contractors for engineering works. He is shown to have been a man of great business and administrative capacity. The sketch of his life brings into relief his high personal qualities and illustrates the fact that he "was one of the first to aim at improving the relations between engineers and contractors, by setting himself against the corrupt practices which were then common."

W. H. W.

EXPERIMENTAL ZOOLOGY.

Experimental-Zoologie. 3: *Phylogenese.* By Dr. H. Przibram. Pp. viii+315+xxiv. plates. (Leipzig und Wien: F. Deuticke, 1910.) Price 18 marks.

THIS volume, the third instalment of the author's work on experimental zoology, is planned on the same lines as the preceding parts; it deals essentially with the nature of species and the origin and modification of specific characters. It gives a concise summary of the work which has been done in various branches of the subject, with short discussions and criticisms where the author considers them necessary. It is on the whole, however, rather an encyclopædia of the phenomena of species than a discussion, as is indicated by the fact that 70 out of 315 pages are devoted to the bibliography and index. In some cases rather more criticism would have been welcome, for the author summarises papers of very different importance with an impartiality which sometimes makes it difficult to gauge the relative value of the work.

In general, the treatment is exceedingly complete, and includes accounts of papers which might have been overlooked without giving just cause for complaint, but there are a few rather surprising omissions. For example, in dealing with heredity, the work of the biometrician school is scarcely mentioned apart from Galton's formulation of the law of ancestral inheritance; Nettleship's Bowman lecture on hereditary eye-diseases is omitted; and still more surprising is the absence of any reference to Gamble and Keeble's work on the effects of coloured surroundings on pigment development. Poulton's work on the same subject is also treated rather inadequately.

The plates are of the semi-diagrammatic kind used in the first volume, and are excellent as illustrations of the text; they are folded so that a plate can be turned out for reference while reading, but it would make it easier to find the plate required if the numbers were visible when they are folded. As in the previous volumes, the use of the letters *a* and *α* is sometimes confusing; in plate vii. we notice that the numbers 4*a* and 4*c* are interchanged, and in the description of plate xxiv., Fig. 14, the use of the word "heterozygote" is misleading. We mention these small defects in the hope that an English translation will be undertaken, in which they may be remedied.

The book opens with a discussion of the criteria of species, in which the importance of physiological characters (blood tests, &c.) is emphasised, and a tabular summary is given of various classes of specific characters. The two short chapters which follow deal with the possibilities of asexual (somatic) and sexual transmission of characters. Chapter iv. consists of a very complete catalogue of experiments in hybridisation, both of crosses between distinct species and between races or varieties. This fills 100 pages, and is most valuable as a list of all the most important cases up to the year 1909. In the succeeding chapter these results are analysed. It is concluded that the first cross (F_1) may show (1) a blend, (2) a mosaic, or (3) alternative appearance of the parental characters. In the F_2 generation the first and second classes may give young all like F_1, or Mendelian segregation may occur; the third class always gives a Mendelian result. The view that Mendelian characters are borne by chromosomes is provisionally accepted. A good account is given of dihybrid and polyhybrid cases, and of the phenomena of "latency" and sex-limited inheritance. In crosses between distinct species the characters often blend, because apparently corresponding characters in different species are not allelomorphic. The relation of Mendel's and Galton's laws to each other is described, and in a discussion of the relation of alternative to blended inheritance a suggestion is made for bringing both into one category.

Chapter vi. (63 pages) gives a summary of work in the production of characters by environment, and their inheritance. Among the work on Protozoa, Dallinger's experiments are not mentioned; and in the long section devoted to the Lepidoptera, we think that a fuller discussion might have been given of the means by which colour-production is influenced by temperature and other factors, as indicated, for example, by Gräfin von Linden's work. The theoretical conclusions to be drawn from this chapter are postponed to the end of the book. In the chapters on selection and mimicry, a good account is given of experiments and observations by various workers, and it is concluded that although natural selection can bring about the survival of the fittest, and although mimicry of a noxious species may be a protection to the mimic, yet selection can originate nothing, but only isolate "pure lines" already existing.

In the final chapter causes of change in specific characters are classified (chemical, mechanical, light, heat, &c.), and finally a valuable discussion is given of the three chief hypotheses of specific change—germinal variation, transmission of somatic acquirements, and parallel effects of environment on soma and germ. The arguments for and against each are set forth in tabular form, and it is concluded that few, if any, observed facts are inconsistent with the third hypothesis, while it has important experimental and circumstantial evidence in its favour.

L. D.

REFERENCE BOOKS OF BIOCHEMISTRY.

Biochemisches Handlexikon. Herausgegeben von Prof. Emil Abderhalden.

iv. Band, 1 Hälfte: *Proteine der Pflanzenwelt, Proteine der Tierwelt, Peptone und Kyrine, Oxydative Abbanprodukte der Proteine, Polypeptide.* Pp. 352. Price 14 marks.

vii. Band, 1 Hälfte: *Gerbstoffe, Flechtenstoffe, Saponine, Bitterstoffe, Terpene.* Pp. 538. Price 22 marks.

(Berlin: J. Springer, 1910.)

THESE two books form the first halves of vols. iv. and vii. of a work in seven volumes on biochemistry, which is intended, as the editor states in the preface, to perform the same function for the biochemist as "Beilstein" does for the organic chemist.

Although the work is termed a hand-lexicon, the articles are arranged as monographs, and there is no discoverable system by which the reader may trace out any detail to which he may want to refer in any one of these long articles. There is no table of contents nor any index to help one, and in any well-regulated laboratory one might almost as well, so far as trouble is concerned, search out the original literature as refer to one of these articles.

For example, one of the best articles in the two half-volumes under review is that on the saponins by Prof. Kobert, of Rostock, occupying 84 pp., and describing nearly as many members of the group as there are pages in the article. There is no apparent method in the arrangement of the description of the members, and nothing to guide us as to where any particular member is to be found. It so happens that the writer is at present working at the biochemistry of an important and well-known saponin occurring in ivy-leaves, and therefore he looked keenly through these 84 pp. to see if there was anything new about it. The search was disappointing; after a long and weary hunt not one word was to be found in the whole article concerning it. This will never do in a work intended to be the biochemical rival of "Beilstein." In that work each volume carries its index, and it is to be hoped that purchasers of the present work will not have to wait longer than the appearance of the second halves of the volumes for the indispensable index.

The two half-volumes which have so far appeared form very dull, dry, and uninteresting reading even for a "Handlexikon," and lack the saving virtues of a lexicon of completeness and ready accessibility to detail.

It would have been an improvement if the articles had been issued as separate monographs; and even then one might question why it was necessary to write some of them at all. Better monographs and more complete have been compiled by other writers in several of the subjects, and are well known and accessible to all workers in biochemistry; and in certain of the others the subject of the monograph is interesting to such a small circle of readers only that it might still be allowed to rest in the original archives, where the half-dozen workers on the subject know quite well where to find the papers they require.

One wonders how many readers will take any deep interest in the wonderfully detailed article of 112 pp. from the pen of Dr. O. Hesse on "Die Flechtenstoffe," under which title, the author informs us at the outset, we are to understand "organic compounds which occur only in the 'Flechten' or lichens, and accordingly are peculiar to these plants." Again, of the very few who have the requisite special training to struggle through Dr. Hesse's article, how many will ever require in the entire course of their lifetime any of the wondrous detail of Dr. Kobert's article on saponins coming immediately after it? There is certainly a deep and abiding comfort in thinking upon the amount of human lore in complete ignorance of which one can pass happily and successfully through this mortal life.

Turning to the articles in the two half-volumes which interest a wider circle of readers, such as those in vol. iv., first part, on the vegetable and animal proteins, their hydrolytic and oxidative products, and the polypeptides, these may be described as somewhat more useful, although the cast-iron form into which they are thrown robs them of much of their interest. One becomes somewhat fatigued by the continuous repetition in mournful, broad-faced type of Vorkommen, Darstellung, Bestimmung, Koagulationstemperatur, physikalische und chemische Eigenschaften, physiologische Eigenschaften, u.s.w. If the monograph form is to be selected for a hand-lexicon, why not give some freedom to the authors to throw the matter into their own form and style, and so infuse some life into what they are writing, instead of dissecting it out in this way like a dead body? An index to each monograph would easily give orientation to anyone looking for a special detail. The cast-iron plan pursued in the present work, moreover, loses space instead of gaining it by continued reiteration of the same facts for each member of a many-membered class. For example, the actions of the digestive juices upon polypeptides could be given in tabular form in a space of one or two pages by putting the whole thing connectedly and together; instead of this, practically the same statements are repeated in describing each member of the legion of polypeptides. Again, in the article on the saponins, the reaction of each individual to the generic colour-test with concentrated sulphuric acid is given with tiresome repetition, as well as many other matters of

a general character, all of which, it may be remarked, have in this article already been given in an introductory description of general properties of the group.

Apart from details, nearly all the articles which deal with subjects of general interest will be found to present a well-known and familiar appearance to the biochemist. Any laboratory which possesses E. Fischer's work on the amino-acids and polypeptides can have little service for the present monograph on the same subject in this series. The article on the vegetable proteins in the "Biochemischen Arbeitsmethoden," written by the same author, edited by the same editor, and issued by the same publishing house (reviewed in NATURE a few months ago), takes much of the wind out of the sails of the article on the "Proteine der Pflanzenwelt" in the present colossal work, which is appearing simultaneously with the equally colossal "Handbuch der biochemischen Arbeitsmethoden" under Prof. Emil Abderhalden's guidance.

There would appear to be a paying market for any large work on chemistry issued in Germany, for that country seems to have become the world's factory for this type of literature, and of all German editors Prof. Emil Abderhalden seems to be the most prolific, as witness the twin works, each of about seven volumes, and each volume so fat that it becomes itself a twin, issuing at the same time under his editorship. But one occasionally feels there can be too much of this thing, and is inclined to cry out, "Halt, halt; we must work as well as read," and spend our money, at least in part, upon materials and equipment for our laboratories, which bid fair to be starved by too much cooking for our libraries.

BENJAMIN MOORE.

METABOLISM OF PLANTS.

Der Stoffwechsel der Pflanzen. By Prof. A. Nathansohn. Pp. viii+472. (Leipzig: Quelle and Meyer, 1910.) Price 12 marks.

THE great advances that have been made in recent years in research into the leading principles and fundamental facts of the physiology of plants have made it necessary to specialise in particular directions, and the literature of the subject shows in consequence a tendency to deal with two aspects of the general life of plants almost entirely apart from one another. Of these the first embraces the phenomena of the individual life; the second, the relations of the individual to the conditions of its environment. In the present volume Dr. Nathansohn has undertaken to deal almost exclusively with the former of these problems, and has set before himself the task of discussing the present position of the metabolic phenomena characteristic of the green plant. The book is not intended to displace the standard text-books on the subject, but to deal more exhaustively than is possible in the latter with the gradual unfolding of knowledge and the gathering together of the mass of detail which has been accumulating for the past decade or longer.

In pursuance of this design he has dealt with his subject in eight sections, following the general line of treatment of his predecessors. Beginning with the absorption of material from the soil and the atmosphere, he deals with the construction and management of foods, certain problems of nutrition, immediate and deferred, respiration and the regulation of energy, and the phenomena of secretion and excretion.

The discussion of the first of these questions, involving the absorption and transport of water, involves the examination of many physical and chemical questions, which are ably handled, with a due avoidance of dogmatism. The author introduces the second problem with a historical summary of the earlier work on the question of photosynthesis, or, as he prefers to call it, carbon dioxide assimilation. It is a little disappointing to find him almost stopping short here with the researches of the Sachsian period, and dealing very briefly with the result of later investigations. His treatment of the metabolic processes and phenomena in which non-nitrogenous substances are concerned leads one to regret that while the sugars are dealt with at great length, he has very little to say about the glucosides, inulin, and the celluloses. The metabolic phenomena in which these are concerned are of considerable importance, and a graphic presentation of them is just now much to be desired. In his treatment of nitrogenous substances, too, Dr. Nathansohn has dealt at some length with the proteins, giving them, as is natural, a position commensurate with their importance in metabolism; but he leaves us wishing he had devoted more space to such bodies as the alkaloids, which he dismisses somewhat briefly.

While appreciating the great amount of valuable material which the book contains, the English reader will be struck with particular deficiencies. The point of view leaves something to be desired. The book treats of the plant as a machine rather than as a living organism. No doubt it is a machine, but it is much more than that; it is capable of regulating all its chemical and physical processes according to its requirements from time to time and to the variation of external conditions. The part played by the living substance in the various changes and rearrangements that constitute metabolism is only too easily lost sight of. It is especially necessary to emphasise this fact, particularly in the discussion of the respiratory phenomena, or one might suppose that the respiratory interchanges take place for the most part without any involvement of the protoplasm, as if sugars, or fats, or what not, are oxidised in the cell by direct action of oxygen upon them. The fact that respiration is an indication of profound auto-decomposition and reconstruction of the protoplasmic molecule might have been made more impressive to the reader of the chapters which deal with this subject.

Another feature which is very remarkable is the narrow range of literature which the author quotes. Out of a total of some 450 references, a bare dozen or so are English, and scarcely more than a score are French. The English reader will certainly regret the very scant attention that has been paid to Eng-

lish researches. Surely in the story of the metabolism of the carbohydrates room might have been found for the classic work of Brown and Morris, and Brown and Escombe on the physiology of the foliage leaf and of the germinating barley grain; in other places for the work of the Cambridge school on the enzymes, the phenomena of gaseous interchange, and the conditions of respiration; and for the researches of Chittenden, Vines, and others on the phenomena of proteolysis. The discovery of erepsin is not mentioned, though its importance in the metabolic phenomena of proteins is beyond dispute. The author is apparently satisfied with the researches of the German scientific world, which, from the point of view of the advancement of knowledge, can only be regretted.

J. R. G.

AGRICULTURAL ESSAYS.

Lectures Agricoles. By Prof. C. Seltensperger. Pp. 576. (Paris: J.-B. Baillière et Fils, 1911.) Price 5 francs.

"IL y a trois manières d'enseigner: on peut instruire en amusant, instruire en ennuyant, et même ennuyer sans instruire." The book before us opens with this incontestable statement, and when we reach the end we feel that the editor has kept well clear both of the second and third methods, and has succeeded in maintaining interest throughout.

The plan of the book is, we believe, entirely new in agriculture. It is not a text-book in the ordinary sense of the word. There is a scheme running through it, but the chapters are not written by one author, or even written expressly for the book, but are taken from the writings of the best known French agriculturists. Thus there is a lack of continuity and an absence of detail, but by way of compensation the reader gets a fine breadth of view, and he is introduced to the best agricultural experts in his country.

M. Schloesing writes on the soil, and succeeds in a very few pages in giving a picture that will carry the student a long way in his studies. M. Nivoit writes on railways and agriculture; he points out that France is not specially rich in minerals, but she has a good soil and an incomparable geographical position; thus a great variety of crops is possible, and good transport facilities become indispensable. Instances are given of what has already been accomplished: the Compagnie Paris-Lyon-Méditerranée carries fruit from Avignon to Paris in 24 hours, to London in 40 hours, to Hamburg and Berlin in 80 hours. The advantage to the grower is enormous, but the local consumer may suffer; where formerly he could often buy fruit at very low prices, he may now have to pay actually more than in some of the markets further off. This, however, is a detail that is easily remedied.

The applications of electricity in agriculture are dealt with by M. Petit. It is regarded only as a source of power, the direct effects of the discharge on plant-growth not being considered. As a driving power it has many advantages, and it is attracting attention in France; for us here, unfortunately, it is as yet inaccessible in country districts.

A number of chapters deal with the general economic and social problems of agriculture. Where there are so many small holdings and so few hedges as in France, the question of boundary lines between one man's property and his neighbours' becomes a fruitful source of dispute and of vexatious litigation. M. Muret deals with this problem, and gives some very useful advice to the disputants.

There are a number of admirable illustrations throughout the volume, which, however, are not always connected with the text, and are sometimes not even explained. In several chapters, especially those dealing with insect and fungoid pests, the absence of detail is felt more than it is elsewhere. References are, however, always given to inexpensive text-books where the further information can be obtained. Considering the very wide range covered—practically the whole of the agriculture of France—and the very modest price of the book, it must be put down as one of the most generally useful of the admirable series to which it belongs.

MICROSCOPY FOR ZOOLOGISTS AND ANATOMISTS.

Grundzüge der mikroskopischen Technik für Zoologen und Anatomen. By A. B. Lee and P. Mayer. Vierte Auflage. Pp. vii+515. (Berlin: R. Friedlander and Son, 1910.)

IN this the fourth edition of an established publication the authors have not found it necessary to make any material alteration in the contents of the previous edition. They have added, however, much new substance derived mainly from various microscopical journals; medical periodicals, numerous though they be, having, to the authors' regret, been almost entirely unproductive. As will be gathered from the title the scope of the work is limited to anatomical and zoological microscopy. Such limitation is strictly observed. Even in the general paragraphs all temptation to wander off into by-paths is sternly resisted. Although the authors give freely of their own experience, they refer largely to the labours of others. The book is, in fact, crowded with condensed information, which has been industriously and exhaustively compiled during the last four years from suitable sources in many languages. References to these sources are always given. Nine chapters (131 pages) are devoted to the preliminary operations of killing, fixing, hardening, and imbedding. Seven chapters (94 pages) deal with staining; five (45 pages) with cements, varnishes, injections, and bleaching. Nine (140 pages) of the remaining ten chapters treat minutely the specific examination of the embryo and of various tissues and organs: one chapter (39 pages) is restricted to invertebrates. There is a copious index of no less than sixty-two pages, so that consultation of the contents is easily made.

A glance at any chapter, or group of chapters, readily reveals the thoroughness of compilation and the judgment of the authors. Thus, the essential process of imbedding is introduced by a general chapter (No. 6) on the subject. This chapter (*inter alia*) summarises the merits and demerits of the chief varieties of microtomes. It also summarises the ad-

vantages and disadvantages of paraffin and celloidin as imbedding materials. Around these much controversy has raged. The authors conclude that, while very thin sections can without doubt be best obtained in celloidin, the greater difficulty of manipulation and the greater requisite dexterity will probably lead an inquirer who wishes to work out a structure quickly and easily to adopt paraffin. As paraffin and celloidin are the chief imbedding agents, each of these is fully treated in a separate chapter, each chapter being of about twenty pages.

The chapters on stains are particularly full, and every colouring medium appears to be included. The recipes for their composition are given with quantitative accuracy, and, in the general preface, Dr. Mayer raises a protest against the vagueness with which such concoctions are frequently quoted. In several cases the important matter of stain durability is suitably discussed. The synonyms of tar dyes are always given.

It may be that to many investigators the most useful chapters will be those which deal specifically with organs and tissues, while other students will perhaps find the chapters on invertebrates the most attractive. Fulness of treatment is as much in evidence in these specialised regions of applied microscopy as in the more general parts of the book. The chapter on embryology (33 pages), for example, covers the animal kingdom; nerves are treated in three chapters (54 pages); and, under the heading of Echinoderms, each of the main subgroups is separately described.

The work as a whole gives the impression of unvarying thoroughness and completeness. It should be a valuable and indispensable auxiliary in the library of every biological laboratory. An appendix, compiled while the book was in the press, brings the contents thoroughly up to date. A. N. D.

DARWINISM AND PHILOSOPHY.

Dogmatism and Evolution: Studies in Modern Philosophy. By Prof. T. de Laguna and Dr. Grace A. de Laguna. Pp. v+259. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THE authors explain that the term "dogmatism" is here used to denote the body of logical assumptions which were generally made by thinkers of all schools (*e.g.* Berkeley and Hume, as well as Descartes and Leibniz) before the rise of theories of social and organic evolution. The first part of the work is devoted to the analysis and illustration of the dogmatic principles. The second part, entitled "Revolution and Reaction," deals with the opposition offered to the old dogmatism by the critical philosophy and absolute idealism. The third part, which is developed to greater length, deals with the pragmatist revolt.

From our naturalist's point of view we turn with most interest to what the authors have to say in regard to the Darwinian theory of evolution, and we are not disappointed. It is shown that while the idea of evolution first became effective in the realm of social science, it was conceived in an essentially abstract fashion, without any adequate consideration of the factors which operated. "It was not until the work of Darwin in biology that there existed anything like a scientific theory of evolution, based on wide and intensive empirical study." But "the importance of Darwin's work did not lie simply in the fact that it provided an acceptable theory of the evolution of organic species." His success gave investigators in other fields confidence in their clue, and opened the way for a universal theory of evolution. Moreover, "the bridging of the gap between man and the lower orders meant a transformation of those sciences dealing with essentially human activities."

While psychology and ethics have developed in post-Darwinian days under the application of evolutionary methods, logic has until recently remained untouched. "Until the rise of pragmatism no thoroughgoing attempt was made to explain the fundamental notions of logic itself in the light of the selection hypothesis." "Pragmatism is the first whole-hearted attempt at an appreciation of the significance of Darwinism for logical theory." What the authors seek to show is that the attempt has only half succeeded;

> "that conceptions and methods inherited from the dogmatic empiricism of the eighteenth century go far to vitiate the evolutionary empiricism of to-day; and that the critical revision of these inherited notions from an evolutionary standpoint will make of pragmatism a far less iconoclastic movement."

The student of organic evolution will be interested in the clear contrast which the authors make between the Darwinian and the Hegelian concepts of evolution. The course of organic evolution is not conceived by biologists as a dialectic; it is not to be explained in terms of mere logical relationship; external circumstances, instead of being unessential, are determining factors. The later stage cannot be described as the necessary realisation of the earlier. "Had external circumstances been ever so little different, the succeeding stages of the process might have been profoundly different." Organic evolution cannot be properly described as the progressive unfolding of a reality potentially existent throughout. Applying the point of this contrast to rational thought, the authors maintain that on the Darwinian view, thought is regarded not as the end and determinant of organic development, but as a product and (more importantly) as a moment or factor in that development—"a factor whose existence and nature are throughout conditioned by the part it has to perform in organic life." J. A. T.

GEOLOGY AND THE DOCTRINE OF DESCENT.

Abstammungstheorie mit Rücksicht auf Erdgeschichte. By Prof. H. Pohlig. Pp. 191. (Stuttgart: Gesellschaft "Neue Weltanschauung" and F. Lehmann, 1909.) Price 2 marks.

SCIENCE in England has been peculiarly fortunate in its popular exponents, especially on the biological side; the only regret is that they are so few. In Germany there is no lack in number, but it would be insincere to express unqualified admiration of the prevailing style. Most of us probably would prefer

Huxley to Haeckel, and the present work is an "Haeckelismus" without the redeeming grace of genius. It is dogmatic, and, still worse, it is dull.

The question of the origin of life is easy to the author. Scattered through infinite space and time is carbon, which in its original state forms the simplest germs of life (Zoatoms). These are so small that even under the highest magnification they are seen only as an irresolvable dust. It is they alone which are able to assimilate the carbon which has lost its life (we are not told how it loses its life). When the earth was molten the Zoatoms surrounded it like an atmosphere, like the meteorites around a heavenly body. Then, of course, come Protists, Protophytes, and Protozoa, and all is plain sailing until we reach the commencement of the Cambrian, where we, for the first time, encounter fossil remains; not, however, representing, as we might expect, the beginnings of life, but all, or almost all, the great subdivisions of the Invertebrata. This remarkable fact has taxed the ingenuity of geologists not a little; the author makes short work of it; two or three pages are devoted to describing the various kinds of rock metamorphism, one or other of which is asserted to have blotted all the pre-Cambrian fossils out of existence, except Eozoon, which is most likely a Stromatopora-like organism, saved by a strange chance from destruction.

Geologists, the author says, have spoken of a Carboniferous continent—Glossopteris land; this is "grund falsch," and contradicted by the facts (which are not cited).

The notion of pre-Tertiary glacial epochs is widely accepted by geologists, but it is "grund falsch" and "unthinkable." A deep sea before the Triassic period is also "unthinkable." No climatic zones were "possible" before the Tertiary era.

The profile of the Pithecanthropoids is still *very* ape-like, as is seen in the lowness of the forehead, the projecting jaws and retreating chin, the slope of the occiput, and the size of the face. (This statement is arrived at by piecing together Neanderthal man and Pithecanthropus.)

After all this, we are glad to be assured that the soul is immortal; it resides in the Zoatoms, and so may be dispersed, but not destroyed.

There are several references in footnotes, almost without exception to other works by the author.

OUR BOOK SHELF.

Grundlagen der Ballonführung. By Prof. R. Emden. Pp. vii+140+Taf. 3. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 2.80 marks.

THIS book contains twenty-two paragraphs or chapters. It opens with a statement of the general laws governing the relations of a balloon to the air which supports it, beginning with the density of the gases employed and their lifting forces, and proceeding with the consideration of the distribution of force in the envelope.

Balloons are classified by the author as being of constant mass or constant volume (*i.e.* as having closed or open envelopes), and the behaviour of the classes in rising and falling is discussed.

The proper use of ballast is treated, and the importance of having too much ballast rather than too little is emphasised. Paragraph 18 deals with captive balloons, especially with regard to the height to which they can ascend in a wind. The diagram illustrating this point appears to be wrong, the construction employed indicating that the height in question is $L(1-\cos\alpha)$, where L is the length of the rope and α its inclination to the vertical, instead of $L\cos\alpha$ (as it should be).

The subsequent paragraphs are connected with the use of the ballonet and the relative merits of closed and open envelopes, and, finally, in paragraph 22 some remarks are made on the steering of dirigible balloons.

There does not appear to be much that is new in the book, but it has the merit of being compact, and most of the information it contains appears to be correct.

For how long frail structures such as balloons will have a place in warfare when opposed to the hardier, cheaper, and quicker flying machines is a question which will be decided in the next few years, but for so long at any rate Dr. Emden's book will be found useful.

A. MALLOCK.

Vaccine Therapy: its Theory and Practice. By Dr. R. W. Allen. Third edition. Pp. x+277. (London: H. K. Lewis, 1910.) Price 7s. 6d. net.

THE principle of treating bacterial infections by vaccines, *i.e.* sterilised preparations of the organisms which are disturbing the normal balance, has taken firm hold in modern English medicine. It has not reached its present position without a struggle, and even now it must be admitted that the proof of its usefulness depends more on the cumulative weight of personal impressions than on any rigid demonstration such as an extensive case-statistic would supply. In practice, however, an increasing body of influential opinion is in its favour, and the acceptance with which former editions of this work has been received shows that it meets a demand.

The present issue, which has been entirely re-written, aims at "enabling the general practitioner to approach with confidence a case requiring therapeutical immunisation." With this object a sketch is given of the nature of opsonins, the use and meaning of the opsonic index, and the method of preparing vaccines, while the various infections are treated at somewhat greater length with regard to their special requirements. A considerable number of individual cases is given to illustrate the selection of appropriate doses, and the results which may reasonably be expected from them in different circumstances. These include failures as well as successes, and the results of recent work in this country are summarised as fully as the scope of the work permits.

As the author himself recognises, however, accurate diagnosis is a prime essential of success, and this presupposes an acquaintance with practical bacteriology, which the general practitioner does not possess, and such a book as this can do little to supply. Some space indeed might well have been saved by omitting the altogether inadequate treatment of the method of isolating and recognising the organisms which may be found in a given case, and devoted to a more critical appreciation of the problems involved in bacterial inoculations.

Die Eiszeit und der vorgeschichtliche Mensch. By Prof. G. Steinmann. Pp. iv+96. (Leipzig: B. G. Teubner, 1910.) Price 1.25 marks.

PROF. STEINMANN, with evident pleasure, contributes this work on the Ice age to a popular series issued by the firm of Teubner. The black letter type shows the audience for which it is intended, and it will admir-

ably carry on the campaign of the German geologists for a more general understanding of the earth. After indicating that an oceanic and moderately cold climate, rather than a continentally extreme one, will provide the conditions for an Ice age, the author appeals to the scenic features of a country where glaciers have worked their way. He supports the view of the over-deepening of valleys by glaciers, and clearly points out the effects of differences of pressure in different regions of a complex ice-stream. Prof. Heim would doubtless remark that the U-form indicated in the picture of the Lauterbrunnen valley (p. 21) is obviously due to taluses; but little fault can be found with the author's account of the variety of characteristic outlines traceable in all regions that have undergone an Ice age.

The etching out of cirques primarily by frost-action, as on the margin of melting snow, rather than by the glaciers that ultimately occupy them, is surely sustainable, in spite of what is said on p. 37; but we agree with the author that the erosive power of glaciers has been very freely underrated. The study of moraines and outwashed materials is used to explain the phenomena of the North German plain, and the lost freshwater lakes of Bolivia are introduced as evidence of the universality of the Ice age. New interest is aroused by the account of pre-Glacial and Glacial man with which the book concludes. G. A. J. C.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Further Experiments with the Gramophone.

In Nature of April 15 and October 21, 1909, I described various experiments with the gramophone. Since then I have made many efforts to get rid of the hissing and grating noises that detract so much from the instrument as a reproducer of musical sounds, and at last I have had an encouraging measure of success. The gramophone, as will be seen in the accompanying figure, is enclosed in a wooden cloth-lined box, and a tube passes tightly through a hole in the wall of the box from the end of the taper arm that carries the sound box of the instrument. When the sound box is tightly closed by raising and locking the front lid, as seen in the figure, the sounds of the machinery, and also the vibrations from the free side of the diaphragm of the sound box, are completely damped off. The noises, caused by the friction of the needle point on the hard disc of the record, pass, of course, along with the musical sounds, through the taper arm to the tube that escapes from the box. This tube is suitably connected with lengths of tin tubing, 1½ inch in diameter, and the sounds are thus conveyed through as many feet of tubing as may be found necessary. I have found the most efficient length of the entire tube, until it reaches the horn or resonator (the attachment of which is seen in the figure), to be, say, 54 feet. The effect of the long tube, while empty, is to increase the volume of the tones, but, of course, the noises are also intensified.

I have always been struck by the fact that the friction noises seem to be quite separate and distinct from the musical tones, either when a voice is singing with an accompaniment, or during the reproduction of an orchestral piece of music—indeed, by an effort of attention, I have so trained myself that I can hear one without hearing the other. This suggests that in the ear there is a mechanism for the detection of noises of high pitch as distinct from ordinary musical tones. It occurred to me that by causing the sounds to pass through numerous narrow channels, freely communicating with each other, the noise-sounds, presumably caused by short waves of high pitch, might be damped off by interference, while the longer waves, corresponding to musical tones, might pass through unaltered, except as regards loss of energy from friction. My purpose was attained by filling a segment of the tin tube, say, from 4 to 8 feet in length, with a mixture of hard peas and beans, corrugated by age or drying. The experiment succeeded. The friction noises were damped down, while the musical tones, although rather "dulled" in quality, that is to say they lacked brilliancy, were purer, and, to my ear, much more natural.

Other substances were tried—glass balls, marbles, small fir cones, gravel, shreds of tin—but the best effect was

Gramophone arranged to get rid of friction noises.

obtained with the peas. Brilliancy was obtained by using, as suggested and made by Mr. Ernest De la Rue (who has been much interested in these researches), zinc tubes filled with fragments of corrugated zinc, and the use of these has been protected by patent by Mr. De la Rue. By a combination of the zinc fragments with the peas and beans, I get delightful effects, so that the gramophone-music is so immensely improved that I cannot listen with any pleasure to the "naked" gramophone sounds, as the attention is not now disturbed by the "frying-pan" noises.

As listening to music so reproduced is a kind of auditory illusion, any contrivance that will heighten the illusion may be expected to give more pleasure if the illusion is of the right kind. Usually one feels a sense of unreality in the music apparently rising from the bottom of the "horn," more especially in listening to a human voice. To get rid of this, I angle the horn, as shown in the figure, so as to reflect the sound waves from a tin reflector (parabolic in character) so placed as to send the sounds to the other side of the room. One then ceases, while listening, to think of either the gramophone or the horn, as the sounds come from the reflector, and the effect is much more real and natural.

I believe the application of this method of "acoustical filtration" may be applied by ingenious mechanics in such a way as to do away with the necessity of building up such an array of tubes as is seen in the figure. The method enables one, in a room of moderate size, to listen to pure music. One cannot help observing how it mellows a voice that, heard in the ordinary way, sounds harsh

(from the production of overtones of high pitch), and how it brings out the pure tones of the string instruments. The various instruments in an orchestra sound better. Everything is reduced in proportion, and, to use an illustration from art, it is like passing from one of Etty's huge pictures to a delicate and beautiful Messonier, in which one sees and appreciates every detail in an area of small dimensions. JOHN G. MCKENDRICK.

A New Variety of Zebra.

WILL you kindly allow me a little space to direct attention to a new and very interesting variety of Grant's zebra, shown in the accompanying photograph sent me by my friend Mr. C. W. Hobley, C.M.G., commissioner at Nairobi, East Africa? The specimen, writes Mr. Hobley, "was obtained by Mr. G. H. Goldfinch, assistant game ranger of the East African Protectorate, a few months ago in the neighbourhood of the Rift Valley. The

animal has a "big whitey patch in the middle of the back, and it came out of a herd which were all the same. I suppose it is a Mendelian 'sport,' which has become dominant in that particular herd, like the white waterbuck on the Euaso Nyiro, north of Kenia."

I propose to call this variety in Mr. Pocock's terminology, *E. quagga*, var. Goldfinchi, or in the old terminology, *E. Burchelli*, var. Goldfinchi. Mr. Hobley adds that the print is a little dark, as "the stripeless saddle on the body is very markedly white in the skin itself."

April 11. WILLIAM RIDGEWAY.

Implements of Moustierian Type from the Rock of Gibraltar.

IN a paper read before the Royal Anthropological Institute on March 7 (NATURE, March 16, pp. 100–101) I gave an account of recent cave-exploration at Gibraltar. In one of the caves thus described, the discovery of various mammalian remains was recorded, together with that of human bones, pottery, and stone implements.

In regard to the latter, a close comparison was made with cave implements, and the similarity of certain examples to implements of the Moustierian type was remarked. But a guarded opinion was given, and this caution, I am now glad to state, seems to have been excessive.

On March 31 Dr. Allen Sturge very kindly examined the specimens with me, and he allows me to record his opinion on four implements submitted to him. The conclusions were fully borne out by comparisons with specimens in Dr. Sturge's magnificent collection. Of the four implements, three (Nos. 2, 7, 13) are judged to be definitely of Moustierian type; the remaining one (No. 15) is either "Moustierian" or "early Aurignacian" (the next and following stage).

Thus out of eleven stone objects (from the cave in question), that are undoubtedly implements and not mere splinters, four are distinctly Palæolithic, and of an early period. So far as I know, Palæolithic implements have not been previously recognised or recorded in connection with the caves of Gibraltar. Moreover, those now mentioned were not accompanied by any polished implements or by any metal objects.

The recognition of Palæoliths of the Moustierian type gives some ground for hope that eventually the whole series of cultural epochs may be established for the caves at Gibraltar, as has been done elsewhere. Further, the discovery of a human skeleton of that period might throw a flood of light on the significance of the Forbes Quarry skull. In any case, exploration will be resumed with increased zest in view of these possibilities.

In conclusion, I would point out that Obermaier seems to hold the opinion that the associations of culture with fauna will be found to differ in the Mediterranean area and in western or central Europe (*L'Anthropologie*, 1909, Tome xx., p. 520). My investigations have already suggested a marked similarity between the Gibraltar caves and some of those at Mentone. Probably the northern limit will be found to include Les Eyzies. Lastly, the preceding remarks are written with full appreciation of the weight of Commont's remarks (1910) as to the significance of isolated examples of implements referable to a particular age. W. L. H. DUCKWORTH.

Anthropological Laboratory, New Museums,
Cambridge, April 5.

Damage done to Skulls and Bones by Termites.

THE extensive damage done to skulls and bones generally in many of the graves of Egypt and Nubia has been attributed to beetles, the bodies of these animals having been found in the earth which is invariably associated with the damaged area, the latter being, in fact, always covered with earth unless it has been knocked off during removal of the skull from the grave.

There is good reason, however, for believing that the damage is the work, not of bettles, but of termites, which still exist in these countries.

These animals, as is well known, never work without covering all their operations with a tunnel or ramification of tunnels composed of earth or grains of sand firmly stuck together by some secretion from the ants themselves. Under cover of these earthworks, they devour whatever substance they have built over, and the destruction is sometimes so complete that nothing but a shell of earth remains, the substructure having been entirely eaten away. In such cases the original form of the destroyed article may be distinctly seen, as the mud covers it in a fairly thin uniform layer, following all its lines and contours. A good example of this was seen at Koshtamna in Nubia, about seventy miles south of Aswan. Here a small wooden statue of a king was still standing in its original position in a tomb chamber, but the crown and more prominent features of the face, completely covered though they were with mud, still preserved the outlines of the form beneath. When, however, the mud was removed, it was found that the statue upon which it had been built was almost completely destroyed, only fragments of the wood being left here and there.

In the case of skulls and bones precisely the same thing happens. A skull is found covered with mud firmly stuck on, and with the traces of the white ants' tunnels running through. If the mud is removed, large areas of the cranial walls may be found to have disappeared altogether. In less exaggerated cases, holes will be seen with white, gnawed edges, or perhaps only the surface of the bone has been attacked. The cranial sutures are a favourite site for the commencement of the termites' operations.

The presence in some cases of the dead bodies of small reddish beetles embedded in the mud on such skulls led to the not unnatural conclusion that they were the authors of

the mischief. The following facts, however, show this to be incorrect.

In the first place, the tunnels, which run in all directions beneath the cake of mud, are too small to contain the beetles found embedded in it.

Secondly, the beetles are found in many other parts where there is no sign of damage to the bone, and quite commonly, in the case of mummies, beneath the linen wrappings where these are in contact with the skin, in which situation they are frequently embedded in the resin or bitumen which has been used in the mummifying process. In these situations there is, of course, no mud whatever, while the damage to the bones is *always* associated with earthworks and tunnels.

Thirdly, though the same earthworks appear in every direction in the grave containing affected bones, on the roof, walls, coffin, &c., no beetles are ever found anywhere in association with such workings except on the body.

Fourthly, in mummified bodies, where the wrappings, soaked in bitumen, are so hard as effectually to have excluded even the ravages of white ants, the works of which may, nevertheless, cover the *outer* surface of such wrappings, beetles are still found in and about the mouth and nose of the mummy, some stuck to the teeth, others to the linen with which the mouth is filled, but *not* in this case on the outer surface of the wrappings, where they ought to be if they were the authors of the earthworks which cover the mummy cloths.

From these facts it seems clear that the beetles were present before the process of mummification was complete, that they became covered over when the body was wrapped, or possibly were not hatched until this was complete, and so are found stuck to the resinous wrappings. In cases where less bitumen or other substance was employed, and the body was merely wound in cloths, the white ants were able to make their way through these with the greatest ease. While doing so they would come in contact with the beetles which had been included in the wrappings, and these would then perforce become embedded in the mass of earth brought up by the termites. It is noteworthy that *complete* bodies of beetles are seldom or never found in the mud. If carefully examined, their heads, legs, and under parts are usually gone, only the tough wing cases remaining, and these are so strong that to a certain point they will resist crushing with the fingers. On the other hand, beetles complete, so far as the naked eye can detect, in every part, even to the delicate antennæ, have been found under the wrappings, and particularly in the neighbourhood of the mouth and nose. The inference from this is, of course, that the white ants devoured the softer parts of the beetles when they found the bodies of these animals in their path, leaving the hard portions stuck in the mud of their buildings.

DOUGLAS E. DERRY.
Anatomical Department, University College,
London, W.C.

What is the genotype of X . . us Jones, 1900, based upon a species erroneously determined as *albus* Smith, 1890?

Statement of Case.—Jones proposes a new genus *X . . us*, 1900, type species *albus* Smith, 1890.

It later develops that *albus* Smith, 1890, as determined by Jones, 1900, is an erroneous determination.

What is the genotype of *X . . us*, 1900; *albus* Smith, 1890, or the form erroneously identified by Jones as *albus* in 1900?

Discussion.—The nomenclatorial problem expressed in the caption of this note is solved in two diametrically opposite ways by different authors.

Some writers maintain that the original *albus* Smith, 1890, is the genotype, while others maintain that the genotype is represented by the species actually studied by Jones and misdetermined as *albus* Smith.

Cases of this general nature have given rise to considerable confusion in nomenclature, and several such cases have been referred to the International Commission on Nomenclature for opinion.

At the last meeting of the Commission, the principles involved came up for discussion, but it was impossible to reach a unanimous agreement. On account of the differences of opinion, the secretary was instructed to make a careful study of a number of cases, and to report upon the same to the Commission.

It is not difficult to foresee that, no matter how the cases are finally decided, great dissatisfaction will arise among zoologists, because the opinion rendered is not the direct opposite of what it eventually will be.

Recognising that this is one of the most difficult cases that has ever been submitted to the Commission, and recognising the fact that, regardless of our action, we shall probably be criticised more on the basis of our decision on this case than because of any other opinion that we have rendered, I am desirous of studying at least 100 cases, if possible, that would come under such a ruling, before my report is formulated.

In view of the foregoing premises, I respectfully request zoologists in different groups to direct my attention to as many instances of this kind as possible with which they are acquainted in their different specialities. Further, since the arguments on both sides of the problem appear to be almost equally valid, it does not seem impossible that the final decision will have to be based upon the arbitrary choice between the two possible rulings, and on this account I am desirous of obtaining all possible arguments on both sides as they occur to different zoologists, and also any personal views based upon convenience or inconvenience, or other grounds, which may be held by different colleagues.

I will hold the case open at least until September 1, for the presentation of arguments by any persons who may desire to submit their views.

C. W. STILES,
Secretary of the Commission.
April 4.

A Kinetic Theory of Gravitation.

As one who for many years has been attracted by the problem of gravitation, I was greatly interested in Mr. C. F. Brush's "Kinetic Theory of Gravitation" (NATURE, March 23), and in Sir Oliver Lodge's letter relating thereto (NATURE, March 30).

About three years ago I made an attempt to examine how far gravitation might be accounted for by waves of compressional type propagated through the æther (cf. *Phil. Mag.*, January, 1909). Before any such theory can be admitted, even as a working hypothesis, it must be shown by rigorous dynamical methods to be capable of accounting for gravitational attraction. This in itself involves no elaborate analysis, though questions arise as to the fundamental nature of matter and of its motion with respect to the æther.

It appears, in opposition to what might readily be supposed, that Mr. Brush's assumption of a directionally indifferent (isotropic) distribution of waves is not needed; a single progressive train of plane-waves would answer equally well. The real difficulties of the theory are encountered when we consider the several effects, other than gravitational attraction, which might arise from the impact of compressional æthereal waves upon atomic matter. It has to be shown that, under admissible assumptions, the *direct* action of the waves would not give rise to any observable phenomena of motion, and that the heating effect might be *nil*, or small enough to escape observation. Other points no less important have also to be considered: they are dealt with at length in my paper.

I fully concur in Sir O. Lodge's objection to regarding the atom "as a foreign substance—a sort of 'grit' in the æther," and, in the paper referred to, matter was treated as of purely æthereal constitution, the motion of a material body through the æther being regarded as unaccompanied by any bodily transference of *ultimate* matter through finite distances. As to whether the gravitative property of matter is essentially bound up with its constitution, or is due to something external, I think Sir O. Lodge will agree that, notwithstanding metaphysical prepossessions (in which I largely share), we should yet keep an open mind. The real solution of the question is perhaps very different from what we are reasonably entitled to expect!

It may be mentioned, however, that some experiments now in progress seem likely to add very considerably to the difficulty of accepting a compressional-wave theory of gravitation.

C. V. BURTON.
Boar's Hill, Oxford, April 2.

DEVELOPMENT OF BRITISH FORESTRY.[1]

THE work on the development of British forestry by Mr. A. C. Forbes, Chief Forestry Inspector to the department of Agriculture for Ireland, will be welcomed by all interested in the question of afforestation. The author deals with his subject in a lucid and convincing manner. To add to the interest of the book, a large number of excellent photographs illustrating the various types of tree-growth in different soils and localities has been included. These alone form a remarkable and instructive photographic survey of the forest conditions not only within the British Empire, but also to some extent on the Continent.

FIG. 1.—Two-storied Beech Wood, Chiltern Hills. From "The Development of British Forestry."

The opening chapter deals with the national aspects of forestry, and here Mr. Forbes has gone to the very foundation of the subject from historical and geographical points of view. The following chapter deals with the forest requirements of the United Kingdom. It is pointed out that, in comparison with other countries, we have the lowest percentage of total land-surface under woodland, with the highest consumption of imported wood per head of population. The writer calculates that, in addition to the three million acres already under trees, we should require to bring another four million acres or so under forests, giving a total of at least seven million acres, equal to about 10 per cent. of the land-surface. The timber production, forest laws, and forest area of other countries are carefully considered in forming an estimate of the requirements of the United Kingdom. Chapter iii. is on the relation of agriculture to forestry development, and here the author shows himself to be equally at home in agriculture and forestry. This is a most valuable chapter, and shows how the area under trees may be extended without unduly disturbing the agricultural value and produce of the country. Chapters iv. and v. deal respectively with climate and tree-growth, and soil and surface conditions in the British Isles; while chapter vi., on the need for improved methods and practice in British forestry shows how vast improvement could be made in our existing woodlands by the adoption of more scientific and up-to-date methods. Chapter vii., on the economic value of the British forest flora, gives a very valuable and interesting account of the sylvicultural characteristic of the trees generally cultivated in Britain. No one is better able to deal with the financial aspects of British forestry than Mr. Forbes, and chapter viii., which treats of this subject, should prove of the greatest interest to all planters.

The final chapter entitled "The State and Private Ownership of Woods" comes as a fitting termination to a work on the development of British forestry. It is here pointed out how the State, and the State alone, can bring about the much-needed improvement in afforestation of the country. The author, however, clearly points out that the cooperation of the individual is necessary if we are to achieve permanent and all-round improvements. In his own words:—"The co-operation of the individual is as necessary in national forestry as in the creation and development of industries, and the idea that the State can entirely take the place of the individual wood-owner is equally absurd as the idea that the latter can succeed without the assistance of the State."

FIG. 2.—Selection Felling in Chiltern Hills Beech Wood. From "The Development of British Forestry."

All through this excellent book the author is moderate in his views and logical in his reasoning. Conclusions are arrived at only after very careful

[1] "The Development of British Forestry." By A. C. Forbes. Pp. xi+274. (London: E. Arnold, 1910.) Price 10s. 6d. net.
"English Woodlands and their Story." By H. Townley. Pp xiii+309. (London: Methuen and Co., Ltd., n.d.) Price 15s. net.

consideration based on personal study and experience. The volume contains many tables of statistics, and is also provided with an excellent index.

"English Woodlands and their Story," by Mr. Houghton Townley, is an interestingly written and well-illustrated work. The book is written more for the forest-lover and student of nature than for the technical forester, but it may be warmly recommended to all interested in any way with trees and forests. The history, traditions, and associations of the old English woodlands and forests are set forth in a most fascinating manner. The laws of olden times, when forests were principally used for the chase, are interestingly described, as well as all matters of historical interest connected with the various forests of England. Nothing could be more interesting than the perusal of this work, which is written in a most readable fashion, and, though not intended as a textbook on forestry, its perusal cannot fail to be of the greatest interest to all foresters and those connected with the management of woodlands, as well as all forest-lovers and students of nature.

THE TROGLODYTES OF EUROPE.[1]

In his excursions into the byways of archæology and primitive culture Mr. Baring-Gould is always interesting and instructive, and in his present book, dealing with the cave-dwelling troglodytes and the cliff castles of Europe, he has found a subject hitherto little explored and well suited to his powers. The moral of the book, though it is nowhere clearly defined, is the essential unity of human culture, man always adapting to his use the material which his environment supplies.

The chalk formation, traceable from the north of Ireland to the Crimea, and from the south of Sweden to Bordeaux, a distance of about 11,140 geographical miles in one direction, and 840 in the other, with its characteristic cavities and the facility of supplementing them by artificial means, naturally provided habitations for prehistoric man; while in other places tufa, volcanic breccia, and sandstone took its place. Palæolithic man shows his artistic powers not only by graving representations of the men and fauna of the period on ivory and bone, but in the wall-paintings of shelters like those at Les Combarelles and Font-de-Gaume he provides a veritable picture gallery. In a cave recently explored have been discovered actual pieces of sculpture of extinct beasts in the round. The preservation of these frescoes and sculptures is due to the fact that the caves have been sealed up from time immemorial, and subjected to no invasion by man or beast or to any change of air or temperature; further, the primitive lamps fed with melted fat could not produce smoke sufficient to discolour ceiling or wall. The genuineness of these paintings is assured by the circumstance that some are partially glazed over and some half obliterated by stalagmitic deposits. This prehistoric savage type of life survives among modern cave-dwellers in Cornwall and in the strange family of troglodytes described by Sir A. Mitchell, who discovered them dwelling in a state of wretched squalor on the shore of Wick Bay. Among subterranean dwellings the wonderful labyrinthine town ascribed to Og, king of Bashan, at Edrei, in the Hauran, is perhaps the most remarkable example. The best parallel to it in Europe is that strange French town, Trôo, on the river Le Loir, which traverses the fertile upland plain of Beauce, and falls into La Loire at Angers. Here the whole height is like a sponge, perforated

The Ruined Monastery in the Rocks, Nottingham Park. From "Cliff Castles and Cave Dwellings of Europe."

[1] "Cliff Castles and Cave Dwellings of Europe." By S. Baring-Gould. Pp. 324. (London: Seeley and Co., Ltd., 1911). Price 12s. 6d. net.

with passages giving access to cells, and store-chambers, most of the houses being wholly or partly underground. In this country we have examples of similar constructions in the Dene-hole chalk quarries of Darenth Wood and those near Chislehurst, the Cornish excavations known as Fogous, the cave in the Isle of Egg, one of the Hebrides, the scene of the terrible massacre of the Macdonalds by the Macleods, and that on Rathlin Island, where a similar tragedy occurred during the campaign of Essex in 1575, of which Froude supplies a graphic narrative.

From structures such as these Mr. Baring-Gould passes on to the cliff castles occupied by the ruffianly Routiers and Free-Companions in France, and the many caves and similar shelters tenanted by hermits and ascetics, robbers, and outlaws in other parts of Europe. The church has also utilised many subterranean excavations of the same kind, such as the monolithic chapel of St. Emilion in Dordogne, and the still more remarkable underground churches at Plouaret in Côtes-du-Nord, and the Spanish example at Cangas-de-Ones, near Oviedo, where a prehistoric dolmen is used as a crypt.

The value of this interesting, if rather discursive, book is much increased by the series of excellent sketches, most of which were drawn by the author on the spot in his exploration of this remarkable series of monuments.

MAJOR GEORGE LAMB, I.M.S.

We regret to record the death, which took place at Edinburgh on April 11, of Major George Lamb, director of the Pasteur Institute of India, Karauli (Punjab), in his forty-second year. He was a distinguished graduate of the University of Glasgow, and for some time demonstrator of anatomy in that university, but resigned this post in order to enter the Indian Medical Service. From the first he strenuously applied himself to research, and the extent and nature of his published work strikingly attest his great ability and originality, and his indefatigable industry. Within a few years after joining the service, he had made his mark by researches on Mediterranean fever in India, typhoid fever, and anti-typhoid vaccine, and other subjects connected with the scientific treatment of disease. He was subsequently continuously employed in important scientific inquiries initiated by the Government of India.

Nearly ten years ago Major Lamb was appointed head of the laboratory for the investigation of snake poisons, and became one of the chief authorities on this subject. The results of his observations appeared in about a dozen papers, which deal with the venoms of Russell's viper, the cobra, and the banded krait, their action on the blood plasma and corpuscles and on the nervous system, and with the specificity of their antisera. He was joint author (with Dr. C. J. Martin, F.R.S.), of the section on "Snake Poison and Snake Bite" in the "System of Medicine," edited by Sir Clifford Allbutt and Dr. Rolleston.

Major Lamb's greatest work was done in connection with the Plague Commission to which he was appointed, as senior member, in 1905. He was responsible for the carrying out of that detailed and widespread inquiry into the mechanism of the epidemic spread of plague in India, the results of which have been published in five reports, the last only recently issued. He initiated and throughout bore a prominent part in the long series of experiments and observations which resulted in the conclusive proof of the transference of plague from rat to rat, and from rats to man by the agency of fleas.

Since his appointment as director of the Pasteur Institute of India, which took place when the plague inquiry was nearing its close, Major Lamb devoted himself largely to the subject of hydrophobia, and introduced important modifications in the treatment of the numerous cases annually dealt with at that institute.

Major Lamb has left an enduring mark upon three main lines of research—snake venoms, plague, and hydrophobia—each of outstanding importance in Indian medical work, to which he devoted himself successively with characteristic zeal, patience, and skill. His frank and genial manner, his clear grasp of, and self-sacrificing devotion to, the work he had in hand called forth, in those privileged to work with or under him, loyal and enthusiastic cooperation. His wide knowledge of medical science in its application to Indian problems will be much missed in medical and scientific circles both at home and in India, and his friends will deplore the loss of one who had a most genial and captivating personality.

J. H. A.

NOTES.

A preliminary programme has been issued for this year's meeting of the British Association, which, as already announced, is to be held at Portsmouth on August 30 and following days. The opening meeting will be held in the Town Hall on Wednesday evening, August 30, when Sir William Ramsay, K.C.B., will assume the presidency and deliver his inaugural address. In the same hall the first evening discourse will be delivered on Friday evening, September 1, by Mr. Leonard Hill, F.R.S., on "The Physiology of Submarine Work," and the second on Monday evening, September 4, by Prof. A. C. Seward, F.R.S., on "Links with the Past in the Plant World." The reception room and administrative offices during the meeting will be established in the Connaught Drill Hall, which is centrally situated close to the Town Hall, and within easy access of all the meeting rooms which will be occupied by the sections. The president will have the assistance of a strong body of representatives of the administrative, ecclesiastical, naval and military interests of the town and neighbourhood, headed by H.R.H. Princess Henry of Battenberg and the Mayor, Alderman T. Scott Foster. An afternoon reception and an evening *fête* are announced to be given by the Mayor, and facilities will be arranged for members to visit sites and objects of scientific, historical, and national interest in Portsmouth and the neighbourhood.

A committee for the study of the sea was appointed in 1909 by the Italian Society for advancement of science. Its work was so active and promising that a few months later the committee was converted by an Act of Parliament into an institution of the Italian kingdom. The Regio Comitato Talassografico Italiano is to be concerned with investigations of the Italian seas from the physical and chemical points of view as well as from the biological. Great importance will be attached to practical questions concerning the navigation and the fisheries. Investigations of the high atmosphere will also be made in connection with aviation. The president of the committee is the Marine Minister, and representatives of the chief institutes, academies, and societies which take interest in sea investigations have been appointed as members. In addition the committee has a scientific staff of its own; it receives a yearly grant from the Italian Government of 60,000 lira (2400*l.*); and the ships for the cruises are supplied by the Italian Royal Navy. Four cruises in the Adriatic sea have

taken place already, the programme of which was agreed upon with the delegates of the Austrian Government. We understand that a fifth cruise will soon start.

It is announced that Mr. J. H. Grisdale has been appointed director of the Dominion Government's Experimental Farm System, in succession to Dr. William Saunders, C.M.G., who has retired.

The death is announced of Colonel I. C. Walker, who from 1881 to 1890 was Chief Conservator of Forests in Madras, and from 1895 to 1898 Inspector-General of Forests in Mysore.

We regret to see the announcement of the death, at ninety-one years of age, of Mr. T. Rupert Jones, F.R.S., formerly professor of geology at the Staff College, Sandhurst, and the author of many papers and essays on geological subjects.

At the meeting of the Faraday Society to be held on Tuesday, May 2, Mr. A. Scott-Hansen, the well-known Norwegian engineer, will deliver a lantern lecture on "Hydro-electric Plants in Norway, and their Application to Electrochemical Industries." On the same evening a paper is down for reading by Mr. Verdon Cutts, of Sheffield, entitled "Electrometallurgy in the Steel Foundry."

On Thursday next, April 27, Prof. R. W. Wood, of the Johns Hopkins University, will begin a course of three lectures at the Royal Institution on "The Optical Properties of Metallic Vapours," these being the Tyndall lectures. The Friday evening discourse on April 28 will be delivered by Prof. W. M. Flinders Petrie on "The Revolutions of Civilisation," on May 5 by Prof. M. O. Forster on "New Organic Compounds of Nitrogen," and on May 12 by Prof. William Stirling on "Biology and the Kinematograph."

The annual conversazione of the Selborne Society will be held on May 5, in the theatre and halls of the Civil Service Commission, Burlington Gardens, W. This year there will be very interesting exhibits of rural industries, including the prehistoric occupation of Flint Knapping, whch still survives in Suffolk, where gun flints and strike-a-lights for tinder boxes to export to tropical countries is still carried on. The president, Lord Avebury, will take the chair in the theatre, and a lecturette will be given on "The Eggs of Butterflies and Moths," illustrated by photographs by Mr. F. Noad Clark.

The 1912 Boston Electric Show will be held in Boston, Massachusetts, U.S.A., from September 28 to October 26, 1912. It will occupy the whole of the great Mechanics' Building, with more than 105,000 square feet of exhibit floor space and accommodations for more than 100,000 visitors at one time. This building is the largest exhibition structure of the kind in the world. The organisation of this electric show, the financial responsibility of its management, and the scope and policies of the great undertaking, are under the auspices and supervision of the Edison Electric Illuminating Company of Boston.

At the Plymouth Laboratory of the Marine Biological Association, the usual Easter vacation course in marine biology was conducted by Prof. W. Garstang, and was attended by seventeen students from Oxford, Cambridge, the Imperial College of Science, Leeds University, and Bedford College. Dr. C. Shearer, of Trinity College, took a class of six Cambridge students to Plymouth for a course of work on experimental embryology. Artificial parthenogenesis of the eggs of *Echinus esculentus* was successfully carried out by the students, and a number of experiments on the lines of work of Loeb and Driesch were repeated. As is usual at this time of the year, the research tables have been well occupied, eleven visiting naturalists, in addition to three on the permanent staff, having been engaged in zoological investigations.

The first non-stop flight from London to Paris was made, on April 12, on a Blériot monoplane by M. Pierre Prier in 3h. 56m. M. Prier, who is the chief instructor of the Blériot School at Hendon, left that ground at 1.37 p.m., taking a course for Dover *via* Hampstead, Highgate, Greenwich, Chatham, and Canterbury. There was a slight north-east wind as he started, which changed to a north-west by the time he reached Dover, at 2.50 p.m. Thirty minutes later he was over Boulogne, and steering a straight course over Abbeville and Beauvais for Paris, where he arrived at 5.33 p.m., making a perfect landing in front of the Blériot sheds at the Issy-les-Moulineaux aviation ground. The height maintained throughout was between 1500 and 2000 feet, except at the Channel crossing, when he rose to more than 3000 feet. The machine was fitted with a 50 horse-power Gnome motor and three special tanks for an extra supply of petrol, of which, however, barely half was used. M. Prier, who found his way by means of a compass designed by M. Blériot and a map, suffered no inconvenience throughout the journey except slight inflammation of the eyes, due to his neglecting to equip himself with goggles.

The council of the Central and Associated Chambers of Agriculture has appointed a committee to report upon the desirability of the adoption of uniform weights and measures. It is not yet clear how this inquiry will be conducted. On previous occasions when local bodies have been consulted, the reports received from them have been of a contradictory character, so that it has appeared hopeless to propose a system likely to meet with general satisfaction among agriculturists. It is improbable that the metric system would meet with much support. An opinion appears to prevail in some quarters that the weights specified in the Corn Returns Act of 1882 for a bushel of wheat, barley, and oats, respectively, are in some way prejudicial to the cereals market in this country. There is also a proposal to apply the term "hundredweight" to the cental of 100 lb., and to fix the stone at 10 lb. instead of 14 lb., as a preliminary to decimalising our present system of weights. A Select Committee of the House of Commons appointed to inquire into the various weights and measures used in the sale of grain reported in 1893, after a lengthy investigation, in favour of the retention of the weights specified in the Corn Returns Act, and also recommended that the sale of all cereals should be in terms of the hundredweight of 112 lb., and that no other weight or measure of capacity should be referred to in any sale.

Dr. John Duncan Gregorson, whose death is reported to have taken place in the recent massacre of the British mission on the Assam frontier, was born in Lochgilphead, Argyllshire, in 1871. He entered the University of Edinburgh in 1889, and graduated M.B., C.M., in 1894. After a course of post-graduate study, he was for several years in practice in Leytonstone, but formed a desire for work in the domain of tropical diseases, which an offer made to him about eight years ago enabled him to fulfil. During this period he was medical officer to a group of tea estates located around Tinsukia, in Upper Assam, and two years ago published, in the Journal of Tropical Medicine, a paper giving some interesting notes on the methods used in combating disease among the coolies imported from

India to work on the tea gardens. The population under his care amounted to about 25,000, consisting of many races from widely different parts and climates of India, scattered over a large extent of country in settlements, each containing about 2000 inhabitants. The part of Assam in which Dr. Gregorson laboured has a climate admirably suited for the spread of malaria and ankylostomiasis, which, along with cholera and dysentery, were the chief diseases he had to combat. His work was carried on under very considerable difficulties in regard to the extent of country to be traversed and number of cases to be seen and treated, but he dealt with the various problems presented in a vigorous and effective manner. His success was evidenced by the respect in which he was held throughout the district, and by his having been invited to sit on a Government commission to inquire into the conditions at a garden where the death-rate had been exceptionally high.

The Secretary for Scotland has appointed the following to be a committee to consider and report on certain questions relating to forestry in Scotland, viz.:—Sir John Stirling-Maxwell, Bart. (chairman), the Right Hon. Lord Lovat, C.B., K.C.V.O., the Right Hon. R. C. Munro-Ferguson, M.P., Mr. John D. Sutherland, Sir John Fleming, Sir Matthew Wallace, and Mr. R. H. N. Sellar. Mr. H. Warre Cornish, Dover House, Whitehall, S.W., will act as secretary to the committee. The terms of the reference to the committee are as follows:—"To report as to the selection of a suitable location for a demonstration forest area in Scotland; the uses, present and prospective, to which such area may be put (including the use that may be made of it by the various forestry teaching centres in Scotland); the staff and equipment required for successful working; the probable cost; and the most suitable form of management. To report as to any further steps following upon the acquisition of the said area which, in the opinion of the committee, it is desirable should be taken with the view of promoting sylviculture in Scotland, due regard being had to the interests of other rural industries."

In *The National Geographic Magazine* for February Mrs. M. L. Oliver gives an interesting account of the remarkable Snake Dance performed by the Hopi Indians at the pueblo town of Oraibi, illustrated by a valuable collection of photographs. This is one of the fertility rites fully described by Prof. J. G. Frazer in the last edition of his "Golden Bough," the legends indicating that the snakes, the progenitors of the tribe, are conciliated as representing the earth spirits. The dance is performed by members of the Antelope clan and by the Snake priests. The latter dance with live rattlesnakes in their mouths, and these at the close of the rite are released at the four points of the compass to wander where they please in the desert. The dance is followed by ceremonial ablution and the liberal use of a powerful emetic to remove the taboo from the officiants.

The Sarawak Museum Journal, of which the first number was issued in February last, makes a good start with a collection of interesting papers describing the resources and people of the State. In the ethnological notes we find a full account of the remarkable Tau Tepang superstition which is current among the sea Dyaks, and particularly among those tribes which are furthest removed from civilisation. The legends of its origin are not uniform. One story tells that a great snake once devastated the land, and that its spirit announced that anyone who succeeded in eating its tongue would gain the hereditary faculty of becoming a Tau Tepang, that is to say, a person whose head possessed the power of leaving its body, and after working mischief during the night, could return to its owner in the morning. Hence all kinds of evil are attributed to such people, who are rigorously excluded from intercourse with their neighbours; and every paddy farm must be carefully guarded with charms, which contain sharp bamboo spikes intended to pierce the face and eyes of any of the Tau Tepang community who may attempt to injure the crops.

Franz de Zeltner gives in *L'Anthropologie* (tome xxii., p. 1) an illustrated account of some caves containing mural paintings which he has discovered in the French Sudan, near Bamako, Boko, Boudoufo, and Kita. They occur near the entrance of rock shelters, so that no artificial light was needed to make them; the colours employed are yellow ochre, red, indigo blue, black, white, and rarely pink; they were laid on with the fingers, as there are no brush marks, and there is no evidence that grease was used in mixing the colours. He found only eight realistic figures, and these occur in only one shelter; everywhere geometric designs predominate. The conventional representations of man and animals recall the rock engravings of Sahara and Egypt. There is no correlation between the different signs, and their grouping appears to be quite haphazard. The author does not believe that the caves ever were dwelling-places, and he definitely rejects the hypothesis of a magical and totemic origin of the painting; indeed, he states that "nothing in the traditions or actual life of the blacks confirms it, quite the contrary, since the representation of their protecting animal is forbidden to them as well as contact with it." New discoveries are recorded of rock pictographs in Aragon and Estremadura (*L'Anthropologie*, *loc. cit.*, p. 119). At present only a preliminary survey has been made; the paintings appear to correspond with the later phases of palæolithic decorative art, indeed, many of them recall the conventional designs of Mas d'Azil, which mark the decadence of the great art of palæolithic times. No traces were found of a neolithic or any subsequent period.

Prof. Pillsbury contributes an interesting paper to the current number of *The Psychological Review* on the place of movement in consciousness. In America, the modern tendency to explain mental processes in terms of movement may be said to have begun with James's well-known theory of the emotions. It has since been extended by Dewey and his school, and has been lately utilised to give impetus to pragmatism in philosophy. Space, even from the time of Berkeley, has received a motor interpretation. Time and rhythm have also been referred to movement. Even memories have been explained as a reinstatement of past movements, and the next logical step would be, as Prof. Pillsbury points out, to suggest that the true quality of sensation is motor. "All that is necessary is to assume that each sense organ is connected with definite muscles, that these muscles are excited whenever the sense organ is stimulated, and that the colour or tones that we see or hear have their origin in some group of muscles rather than in a sense organ or in the cortex." The author points out that nothing is gained by such conceptions if we hold the current view that movements themselves are only known through sensations. He cites the results of recent experiments on the motor cortex of living man, which show that the motor impulses originating from the motor cortex contribute nothing directly to consciousness. "Granted that movements are only known by the kinæsthetic sensations, to translate all conscious qualities into motor terms merely transforms all other sorts of sensation into the one sense, and that a sense

relatively poor in qualities." But where the motor theory most completely breaks down is when it attempts to explain functional problems. Meaning, thinking, recognising, have all been tentatively explained in terms of motor theory. Now "movements in and of themselves have no meaning, are not immediately recognised nor understood. These functions require just as much explanation when they attach to movements as to any mental process." Function is evidently something more than movement; use is something more than structure. As the author points out, "more important than either sensation by itself or movement by itself is the fact that consciousness is always an organised system."

In *The Entomologist's Monthly Magazine* for April Mr. G. H. Verrall adds one hundred species of Diptera to the British list. Of these, seven are entered as new species, but since there is no diagnosis, these would appear to be *nomina nuda*, which may be appropriated by anyone else.

The Bergens Museum *Aarsberetning* for 1910 contains a brief account of the recent Atlantic cruise of the *Michael Sars*, financed and directed by Sir John Murray. The collections, it appears, are to be worked out at the Bergen Museum, where the types of new forms will be preserved.

According to an article by Dr. Bather in the March number of *The Museums Journal*, the Muses are to have no roof over their heads in some of their habitations, for the movement in favour of open-air museums is stated to be making distinct progress. Such establishments will be, of course, for the display of antiquities not liable to deterioration by exposure to the weather, and they will certainly have the advantage of cheapness. It is satisfactory to note that Dr. Bather considers the exhibition of local objects should be the main function of local museums, their first duty being "to interest the people of their city or county in their own history."

The *Bulletin Scientifique de la France et de la Belgique* is making a praiseworthy effort to advance the assimilation of current scientific literature by publishing an annual "Bibliographia Evolutionis," which is to record not only the titles of books and papers, but likewise to give a *précis* of their contents. The present issue, of which we have been favoured with a copy, deals with the year 1910, and contains 345 items. The compilers are to be congratulated on the celerity with which they have accomplished this work, and are entitled to the gratitude of all students of subjects connected with evolution, both as regards zoology and botany.

In connection with the arrival of the first living elephant-seal at our own Zoological Gardens, to which reference has been made in Nature already, it is interesting to note that, according to *Science*, half-a-dozen young elephant-seals from Guadalupe Island, on the Californian coast, have been received at the New York Aquarium in excellent condition. Although not more than nine months old, these young monsters average about 250 lb. in weight, and measure from 4½ to 5 feet in length. Although described as a distinct species (*Macrorhinus angustirostris*), the Guadalupe sea-elephant is identified by Mr. Rothschild with the typical *M. leoninus* of Juan Fernandez, the Crozet form, to which the London specimen belongs, being regarded by him as a race of the same species.

The habits and life-history of pycnogonids (Pantopoda) form the subject of an illustrated article by Mr. H. Prell in the third part of the Bergens Museum *Aarbog* for 1910. If kept in cold water, the members of the genus Nymphon flourish in aquariums. All of them crawl, but a few are also able to swim by the aid of swimming-hairs, which are more strongly developed in males than in females. They feed entirely on Hydrozoa, more especially Campanulariidæ, and the curious mode in which these organisms are seized and devoured is well shown in the illustrations. The species of Pycnogonum which are parasitic on sea-anemones, the juices of which they suck, are, on the other hand, much more difficult to keep in confinement.

The accepted classification of the brittle-stars (Ophiuroidea), according to Mr. H. L. Clark in a paper, of 302 pages, published as Bulletin No. 75 of the U.S. National Museum, is little short of an absurdity, nor has any attempt been made for the last thirty years to put it on a rational basis. Unfortunately, the author has not found himself in a position to remedy this unsatisfactory state of affairs, and he has therefore followed a classification based on a compilation of the work of Lyman and some of his successors. Mr. Clark's paper relates to the North Pacific representatives of the group, of which an enormous collection, comprising more than 40,000 specimens, referable to about 190 species, were at his disposal, the bulk of these having been collected by the *Albatross* during various cruises to and from Alaska, Bering Sea, and Japan. Out of 189 species, no fewer than 112 are from south Japanese waters, to which most of them are restricted. This Honshu fauna, as it is called by the author, is evidently related to the still richer Oriental ophiurid fauna, although only about a dozen species are at present common to the two. The Bering Sea fauna is very distinct from that of Honshu, although the two are connected by a group of sixteen common species. Other points brought out in the monograph are the occurrence of West Indian species in the North Pacific, and evidence in favour of the existence of a distinct circumpolar fauna.

A valuable paper on the post-larval development and minute anatomy in the genera Scalpellum and Ibla has been lately published by Dr. F. H. Stewart in the Memoirs of the Indian Museum (vol. iii., No. 2, 1911). The author has been able to supplement, in some important particulars, the accounts of cirripede development as given in Darwin's classical Ray Society Monograph and in Hoek's well-known contribution to the *Challenger* Reports. There are four plates of excellent drawings representing stages between the cyprid-larva and the adult, mostly taken from species of Scalpellum. It will be remembered by students of the barnacles that while Darwin and Hoek had stated the dwarf male forms of Scalpellum and Ibla to be sexually pure, Gruvel at a later date (1899) claimed to detect rudimentary ovaries in the peduncle of the male *Scalpellum peronii*. Dr. Stewart fails to find in *S. squamuliferum*, and also in a specimen of *S. peronii* itself, any cells that can be regarded as ova, and his descriptions suggest the probability of Gruvel's "cellules ovariennes non développées" being, in truth, large cement-gland cells. Dr. Stewart has also established the absence of any trace of a testis in the female *Ibla cumingii*. His work therefore confirms Darwin's distinction of truly unisexual forms, hermaphrodite forms, and pure dwarf-males among the barnacles.

A lengthy paper in Russian by Mr. S. Kostytschew, dealing with respiration phenomena in plants, is published in the botanical section (No. 1) of "Travaux de la Société Impériale des naturalistes de St. Pétersbourg" (vol. xlii.). From his experiments and conclusions derived therefrom

the author constructs the following theory:—There are two distinct processes to be considered in respiration. On one hand, there is absorption of oxygen leading to the formation of certain oxidising substances, notably peroxides, and on the other, decomposition of sugar by a ferment. The immediate products of fermentation may give rise to alcohol, or, under the action of peroxides, may be fully oxidised to carbon dioxide and water.

THE administration report for 1909 of the Ceylon Botanic Garden, prepared by the acting director, Mr. R. H. Lock, together with the supplemental report by other officers, has recently come to hand. Reference is made to the importation of agricultural machinery and tools, not only for planters' estates, but also for the rice lands cultivated by natives. The shot-hole borer, *Xyleborus fornicatus*, a pest on tea bushes, has engaged the attention of the entomologist, Mr. E. E. Green. The historic scourge of the coffee plant, the green bug, *Lecanium viride*, was reported from one district as another pest on tea, and a slug, *Mariaella dussumieri*, was notified as a destructive feeder on young rubber plants. The curator records the first flowering of the apocynaceous shrub *Stemmadenia bella*, and the planting of an avenue of the beautiful pink-flowered variety of *Lagerstroemia Flos-reginae*.

AN important and very useful contribution to hepaticology is provided by Mr. S. M. Macvicar in an enumeration and account of the distribution of liverworts in Scotland, which has been published as the twentieth volume of the Transactions and Records of the Botanical Society of Edinburgh. The compilation of localities and collectors for each species is in itself a formidable task, even when assisted by the cooperation of correspondents. In addition, the author has added to the Scotch records many more new species than any other collector; *Aneura incurvata, Adelanthus decipiens, Acrobollus wilsonii*, and *Calypogeia succica* are four out of several species found as yet by Mr. Macvicar alone. The floristic sketch of the seven botanical provinces contains many interesting details. Considered from an ecological point of view, hepatici become dominant on some of the higher mountain tops, where a Marsupella-Gynomitrium association is often developed. The coterie of Atlantic species is the most important and remarkable, as some of them would be classed as subtropical and do not occur otherwise in Europe.

A PAPER on fungous root tubercles, communicated by Mr. E. G. Arzberger to the twenty-first report of the Missouri Botanic Garden, deals with conditions examined in *Ceanothus americanus, Elaeagnus argentea*, and *Myrica cerifera*; at the same time it is stated that apparently all species of Ceanothus and Myrica possess them to some extent. The course of events was found to be very similar for Ceanothus and Elæagnus. The fungus enters a young root, and in consequence a tubercle is formed; hypertrophy leads to the development of a large cortex in which the fungal mycelium ramifies; the nuclei of the invaded cortical cells increase abnormally; then the fungus forms vesicles, regarded by the author as sporangia, and absorbs nucleus and cytoplasm of the host cell; subsequently the fungal cells disappear. In the case of Myrica there is no tendency to break up the contents of the vesicular structures, and the form of the fungus indicates that it belongs to the genus Actinomyces.

BESIDES the vast store of archæological information which Dr. M. Aurel Stein brought back from Chinese Turkestan and Western Kansu, he and his assistants from the Survey of India carried out a very large amount of careful topographical surveying, which very greatly improves the maps of that region. Plane-table surveys were carried on continuously during the journeys, and these were controlled by astronomical observations for latitude made at seventy-two stations, and by others made during a previous journey in 1900–1. From this material ninety-four sheets are being prepared by the Survey of India on the scale of 1 : 253,440, and will be published in the form of an atlas to accompany the detailed report on the scientific results of Dr. Stein's last journey. In the meantime reduced copies have been published by the Royal Geographical Society in the Journal for March. The whole area from Kashgar to Kan-Chou (long. 75°–101°), including the Takla Makan desert and the mountains bounding it, is plotted on the scale of 1 : 3,000,000. Other maps on the scale of 1 : 1,000,000 show the Kun-Lun range on the frontier of Kashmir, and Western and Central Nan-Shan to the eastward. On all these maps, heights which have been determined by triangulation, or by barometric or clinometric observations, are shown, names have been carefully revised, and the areas occupied by cultivation, scrub or jungle, and desert have been distinguished. The whole forms a most valuable addition to Asiatic cartography.

THE monthly meteorological charts for May issued by the U.S. Weather Bureau for the oceans and for the Great Lakes of North America have been received. Among the various data, in addition to the usual mean values, we may mention an article (on the back of the charts) entitled "Weather Lore of the Sea," which includes a large collection of proverbs. These are not given as unfailing signs of coming weather; in fact, it is pointed out that for some, depending on celestial bodies, such as moon and stars, careful records fail to show the slightest influence, but the mariner may find it interesting to verify others at his convenience. The Deutsche Seewarte also makes good use of the space available at the back of such charts. The North Atlantic chart for April contains a detailed account of the quick voyage of the sailing ship *Potosi* to the west coast of South America and back, together with useful remarks as to the course and the advantage taken of actual and average weather conditions.

WHILE the reports published in NATURE furnish an indication of the papers read before the London Mathematical Society, considerable interest attaches to the annual volume in which these papers are published, as affording a survey of the year's work. The Proceedings of the London Mathematical Society for 1910 (London, Francis Hodgson, 1910) shows the same high standard that has been maintained in previous years, and contains thirty papers, notable among which are five important contributions to analysis by Dr. W. H. Young, F.R.S., and papers by Bateman, Hardy, Dixon, Hobson, Lamb, Watson, and others, altogether twenty mathematicians having contributed to the present volume. In applied mathematics we have papers on electrodynamical questions by Bateman, Cunningham, Hassé, and Larmor, on heat by Carslaw, on diffraction by Lamb, and on attractions by Leathem. The importance of maintaining and further stimulating interest in these proceedings will be evident when we compare the output of English mathematical original work with what is being accomplished elsewhere, particularly in America. We have, in addition to the present "Proceedings," our "Quarterly" and our "Messenger," but if a quantitative test is of any value, the American Society's Bulletin and Transactions,

the American Journal and the Annals certainly have the lead. As regards quality, a comparison is not so easily made. In America groups are now receiving most attention; in the present volume analysis largely preponderates.

According to a copy of a paper in the Bulletin of the Academy of Sciences of Cracow which has reached us, M. H. Merczyng has succeeded in measuring the refractive indices of water and alcohol for electrical waves of 4·5 and 3·5 centimetres, produced by means of a Righi oscillator working in petroleum. The rays sent out by the oscillator are rendered parallel by passing through a spherical flask filled with petroleum, and then fall at an angle of about 40° on the surface of the liquid. The reflected beam is received by a parabolic mirror, which concentrates it on to a thermo-junction. From the angle of incidence and the ratio of the intensities of the reflected and incident beams, the refractive index of the liquid is calculated. The wave lengths are measured by the Fresnel double mirror method. The results obtained, when compared with the known results for longer waves, show that in both cases the region in the neighbourhood of 4 centimetres is one of anomalous dispersion, the refractive indices increasing as the wave-length increases.

Messrs. E. R. Norman and Co., 26 Great George Street, Leeds, have issued a pamphlet describing the Sytam system of making notes and filing papers. The system consists of methods of binding together loose sheets of paper which can be readily introduced or removed or changed in position, forming a compact book. There are four different kinds of mechanism suitable for binding together sheets of various sizes, which range from $3 \times 2\frac{1}{16}$ to $13\frac{1}{2} \times 9\frac{1}{2}$ inches. The system appears to be quite practical and easy of application; we have seen a large ledger in which sheets are arranged for the D schedule (chemistry) of the International Catalogue, the names of the sections of the schedule being indicated by projecting tabs on the edges of the sheets, which renders reference very easy.

"Remarkable Eclipses" and "Remarkable Comets," both by Mr. W. T. Lynn, have just been issued in their eleventh and fifteenth editions, respectively, by Messrs. Samuel Bagster and Sons, Ltd. Both have been brought right up to date, and the most remarkable feature of each is the enormous amount of information compressed within so small a compass and sold at the low price of 6*d*. each net. The former volume includes notes on the most remarkable eclipses of the sun since 1063 B.C., and of the moon since 721 B.C., while the second briefly describes all the remarkable comets of which history speaks, even though it be with far-off whispers. An excellent drawing of Halley's comet, as seen by Miss E. M. Phillips at Barbados on May 17, 1910, is an additional feature, new in this edition.

The April issue of Mr. C. Baker's quarterly classified list of second-hand instruments contains a description of more than 1500 pieces of scientific apparatus for sale or hire at Mr. Baker's second-hand department, 244 High Holborn, London.

In Mr. E. P. Stebbing's paper on "Tree Planting in Towns," on p. 197, col. 1, of Nature of April 6, the word "Etna" should have been "Everest." Mr. Stebbing asks us to correct this error, which was made by his typist, and was overlooked by him in the proof of the paper submitted to him.

OUR ASTRONOMICAL COLUMN.

April Meteors.—Mr. W. F. Denning writes:—"The April meteoric shower will occur this year when there will be little moonlight. With clear skies it ought to be very satisfactorily observed, but the character of its return cannot be predicted.

"On April 19, 1803, there was a fine display, but it has not returned in the same abundance during the 108 years which have clapsed since the date alluded to. There is no reason to anticipate a brilliant exhibition this year, but the sky should be vigilantly watched on the nights of April 20, 21, and 22, so that if the shower actively returns it may be suitably recorded. It is often of short duration, and true Lyrids are rarely, if ever, observed before April 17 or after April 24.

"From observations made at Bristol since 1873, I certainly believe that the radiant point is liable to the same easterly motion as that which affects the emanating centre of the Perseids. But the April stream supplies so few meteors, except on the date of maximum, that it is extremely difficult to get the precise position of the radiant point on the 17th and 18th, and 23rd and 24th. Observers would do well to gather as many apparent paths as possible on the nights just named. Records of meteors obtained at two stations would be specially valuable as serving to indicate the point of radiation accurately. On April 18, 1901, 13h. 19m., a bright Lyrid was recorded by Prof. Herschel at Slough, and by the writer at Bristol, and the radiant was indicated at $266° + 33°$. This object afforded evidence that the Lyrid focus is a changeable one, for its centre is at $270° + 32°$ on April 20. Additional observations of similar character would supply valuable details bearing on an interesting feature of the display."

The Spectrum of Nova Lacertæ.—Spectrograms of Nova Lacertæ were secured at the Potsdam Observatory on January 6, 7, 8, and 23, and are described by Prof. Münch in No. 4490 of the *Astronomische Nachrichten*. The wave-lengths were determined by taking the mean measured wave-lengths of the hydrogen lines as normal, and then interpolating the other measures. Naturally, no rigid accuracy is claimed for the values as being absolute, but the table is a useful record of the lines seen and of their various intensities and characters. On January 7 $H\gamma$ and $H\delta$ were sharply defined on the red side, but diffuse on their more refrangible edges, where they were accompanied by broad absorption bands: the maximum intensity lay on the red side of each line; on the other hand, $H\epsilon$ and $H\zeta$ were equally sharp on both sides. The usual decrease in the intensity of the continuous spectrum took place, and on January 23 it was much fainter than on January 7. Prof. Münch discusses the intensity curve of the nova spectrum, and by a comparison of the distribution of energy therein shown with that given by several stars of the A type, he derives an energy curve for the nova.

The Different Quality of the Light Reflected from Various Parts of the Lunar Surface.—It will be remembered that Prof. R. W. Wood found recently that, when photographed in ultra-violet light, various features on the moon presented different appearances from those presented on ordinary photographs.

Working at the Charlottenburg Technischen Hochschule, Herren A. Miethe and B. Seegert have carried the investigation a step further by using two screens in connection with a reflector, one of which transmitted light of wave-lengths 360–330 $\mu\mu$, the other light of wave-lengths 700–600 $\mu\mu$. A comparison of the plates so obtained shows remarkable differences of illumination, especially on some of the surfaces of the *maria*. The higher parts of the lunar surface, especially in the region of the south pole and about the ring mountains of Copernicus, reflect hardly any ultra-violet light, while the north polar regions reflect a great deal. By projecting the two photographs through complementary screens, the differentiation of colour is brought out remarkably, the Sinus Roris and Mare Nubium showing remarkable variations (*Astronomische Nachrichten*, No. 4489).

The Pyrheliometric Scale.—A paper with important bearing on the question of the value of the solar constant is published by Messrs. Abbot and Aldrich in No. 3, vol.

xxxiii., of *The Astrophysical Journal.* Feeling dissatisfied with the Crova alcohol actinometer obtained in 1902, Mr. Abbot conceived the idea of constructing a new form of pyrheliometer. This consists of a double walled, large test-tube blackened within, with a stream of water circulating between the double walls and absorbing the heat collected inside the chamber. The sun's rays shine into this chamber through a measured orifice, and the heat collected by the water is measured by a system of platinum wires forming a resistance thermometer.

Test experiments with electrically heated coils, in which the heat could be measured with great accuracy, have shown that the water system collects all the heat introduced within 1 per cent., and that the solar heat can be collected and measured to within 0·2 per cent. Thus the scale of the solar-constant observations of the Astrophysical Observatory is reduced to the absolute scale of calories (15° C.) per square centimetre per minute within a probable error of 0·2 per cent., an accuracy hitherto not attained.

DOUBLE-STAR OBSERVATIONS. Circular No. 6 of the Transvaal Observatory contains a list of about 350 double stars discovered with the 9-inch Grubb refractor of the observatory during 1910. Mr. Innes directs attention to the common statement that the southern heavens offer a practically unexplored field to the would-be double-star discoverer, and shows that this is by no means the case. The circular also contains a list of double stars discovered by Mr. Ward at Wanganui, New Zealand. The list contained observations of 212 stars, but has been revised, and in some cases the observations confirmed, by Mr. Innes.

Nos. 4486 and 4488 of the *Astronomische Nachrichten* also contain series of double-star measures, the former by Herr J. Voûte at the Leyden Observatory, the second a longer list of micrometer measures by Prof. H. E. Lau at Copenhagen.

MICROMETRICAL MEASUREMENTS OF NEBULÆ.—A useful catalogue of nebulæ lying south of the equator is published as No. 17 of the Publications of the Cincinnati Observatory. In the preface Prof. Porter explains that when the 16-inch Clark refractor was ready for work at the end of 1904 it was decided to observe those nebulæ of Dreyer's N.G.C. which have southern declinations, and the work has been carried on since. There was no idea of discovering new objects, but seventeen were found, of which nine appear certainly to be novæ. The catalogue includes the positions of 669 objects, with the micrometrical measures of them and of the companion stars.

THE MOTION OF CERTAIN STARS IN SPACE.—As an extract from the *Bulletin Astronomique*, we have received a paper in which Prof. Stroobant discusses the question of the sun being a member of a group of stars having a common motion through space. In the result, he finds a fairly strong indication that the sun does belong to such a system, which also comprises the stars α Cassiopeiæ, β Persei, α Persei, α Scorpionis, γ Cygni, and ϵ and α Pegasi.

THE COMPOSITION OF THE GASES CAUSED BY BLASTING IN MINES.[1]

THE report before us was drawn up for the Government of Western Australia by Mr. E. A. Mann, the Chief Inspector of Explosives. The importance of investigations on the subject of the composition of gases caused by blasting in mines cannot be overestimated, since, hand in hand with the safety in actual use of blasting explosives, there is the possibility of accidents arising from the products of the explosion accumulating in badly ventilated headings. This risk has been recognised by several Governments, and investigations instituted. In the present case a most valuable and suggestive report is the outcome.

Nitroglycerine is the only largely employed explosive which contains more than sufficient oxygen for its complete combustion, and on firing should therefore yield only carbon dioxide, nitrogen, water vapour, and an excess of oxygen. The explosives investigated were mainly nitroglycerin explosives: blasting gelatin (nitroglycerin with approximately 10 per cent. soluble nitrocellulose), gelatin dynamite, and gelignite, both of which contain wood meal and potassium nitrate. Generally speaking, the former contains a slight deficiency of oxygen, whilst the latter two an excess.

The gases produced on firing under actual working conditions were collected by Mr. Mann, who wore for the purpose a Fleuss oxygen apparatus. In all 131 entries were made into the dangerous gases, and analysis invariably showed that carbon monoxide, which is so highly poisonous, was produced, together with small quantities of oxides of nitrogen, dangerous by reason of their physiological activity.

An important ratio obtained is that between $CO : CO_2$, which is a fair measure of the relative dangers of gas-poisoning with the different explosives. The highest is found with blasting gelatin (1 : 6·5), a general average for all the explosives being about 1 : 13. It is well known that pressure on firing exercises an enormous difference in the distribution of oxygen to form carbon dioxide or monoxide, high pressures increasing the CO_2, and this has an important bearing in practice. If the explosives mentioned are fired in a bomb, the maximum oxidation results, since maximum pressure is attained. In a rock, the greater the resistance, either from its character or the position of the charge, the lower should be the ratio $CO : CO_2$. The ideal condition would be where the rock only gives just when the maximum pressure is reached; but this is a condition impossible to realise in practice, so that holes are invariably overcharged, *i.e.* the rock is blown out before oxidation has been completed, hence the production of carbon monoxide.

Two very important points are brought out, first, the influence of the paper wrapper of the cartridge, which gives a deficiency of oxygen on the whole charge. Comparative tests with and without wrappers show that in the case of gelignite the ratio $CO : CO_2$ has been reduced from 1 : 16 to 1 : 51, and in the case of blasting gelatin from 1·95 to 1 : 52. Secondly, the influence of the physical condition of the powder; where the most intimate mixture of the ingredients is obtained, there is every chance of oxidation proceeding more rapidly to the maximum actually obtainable before rupture of the rock. Some excellent coloured plates of the microstructure of many of the explosives under polarised light emphasise the frequent heterogeneity of their structure.

The effect of fuse firing as compared with electric firing is carefully considered, and everything is greatly in favour of the electrically fired charge, fuses being responsible for much deleterious gas.

[1] Report on investigations into the Composition of the Gases caused by Blasting in Mines, by E. A. Mann, Chief Inspector of Explosives for Western Australia. (Perth: by authority: Fred. Wm. Simpson, Government printer.)

DRAINAGE AND MALARIA.

IN India, the sanitary expert adviser of the complacent type must either "bend or break" under the weight of official opinion (held as strongly by the youngest Under-Secretary as the veteran Financial Member) that the Sanitary Department must be classed financially as "unproductive," and must therefore be, in its representations involving expense, tactfully unobtrusive. Hence, possibly, the unconscious evolution of the policy of "quinine prophylaxis," which would relieve the Government of India from applications for loans and "free grants" for radical anti-malarial measures, such as drainage works, requiring the sinking of capital, and would throw upon the inhabitants of malarious areas (who are notoriously impecunious as a sequence of disability to labour) the onus of purchasing an expensive drug—through an indefinite number of years.

In connection with the letter in NATURE of February 9 by Dr. Bentley—one of the small circle of supporters of this policy—and the reply thereto by Dr. Malcolm Watson, there is now available a record[1] of facts at issue, which will enable those interested in a question of much import-

[1] "The Prevention of Malaria in the Federated Malay States." By Dr. Malcolm Watson, with a preface by Prof. Ronald Ross, C.B., F.R.S. Pp. 139. (Liverpool: School of Tropical Medicine, 1911). Price 7s. 6d.

ance to communities of tropical countries, and, consequently, of our national commerce, to draw their own conclusions. Readers of this very valuable statement of work fulfilled and observations made by a keen and practical sanitarian will find no difficulty in recognising that the "marked rise of subsoil water," which coincided with the increased incidence of malarial fevers, was the "special influence" at work in Klang; that this occurred in an already malarious town in constant communication with surrounding malarious areas, with the result that transfer of infected inhabitants to the swamps of Port Swettenham found ready-made conditions for the continuance, if not aggravation, of epidemic malaria; and, consequently, the increased incidence was not due to the ephemeral effect of importation of ill-fed coolies, but primarily to local physical conditions remediable, and actually remedied, by judicious engineering operations.

This record shows that in Klang and Port Swettenham the abolition of pools by drainage (without the aid of quinine prophylaxis in the former case, even as a temporary measure) rapidly rendered possible commercial undertakings of great monetary value, which had been interrupted on account of disability of the available labour; that whilst there obviously is no desire on the part of the author to belittle the utility of quinine prophylaxis, he found that to secure maintenance of coolie labour upon estates the daily consumption of quinine necessary, under careful supervision of the subjects, was in quantities that a free Indian population could neither afford nor be persuaded to take; that the survivors of this temporising effort remained at the end of two and three years of daily administration of quinine the bearers of malaria parasites, and therefore were a danger to themselves and their neighbours; and that by effectual removal of surplus moisture of the soil, there is excluded fear of epidemic malaria following the introduction of malaria-parasite bearers—an "influence" which, in the absence of drainage, certainly cannot be ignored. Nor is it only in Klang and Swettenham that these results have been illustrated, but in several planting estates, where previously the loss by coolie labour paid for, but unavailable from sickness and death, was of grave moment; here also has been gathered valuable information as to the necessary radius of protective zones.

Seeing that, in accordance with the policy of the sanitary expert advisers of the Government of India, the Punjab Government has recently inaugurated an anti-malarial campaign by purchasing *a ton of quinine*, it is not likely that the amount of this drug found necessary by Dr. Malcolm Watson for the mitigation—not eradication—of malaria in a free population will surprise them. The Government of Eastern Bengal and Assam has, however, adopted a method more likely to be grasped by the people; whilst assigning drug prophylaxis to the millennium, it, in the meantime, asks its malaria-stricken populations to indulge in the so-called quinine "treatments" at three annas *per* head *per* attack—or a sum exceeding the total average annual taxation *per* head on account of district boards serving under it.[1] In this case, presuming two attacks *per annum per* head in a population of 15,421, there would be spent (in one sense) "unproductively" against a preventable disease sufficient to meet the sinking fund and interest, by annual instalments, of a loan for thirty years of one lakh of rupees. Yet the chances are that were a lakh sunk in any well-designed anti-malarial drainage scheme, there would be illustrated the truism that "prevention is better than cure"—both for commercial and humanitarian reasons.

W. G. King.

SOME PAPERS ON INVERTEBRATES.

In the report of the Government entomologist, issued by the U.S. Department of Agriculture, for 1910, will be found a full account of the work accomplished during the year under review, and a scheme for future work. Certain points connected with the life-history of the brown-tail and the gipsy moth engaged attention during the year, more especially the presence of isolated colonies of the latter in woodland districts. As the result of these investigations, it was found that newly hatched caterpillars may be carried by wind to a distance of nearly 2000 feet. Of late years the Argentine ant has caused such damage to orange-plantations in Louisiana that several have been abandoned, but it is believed that a practical method of keeping this pest in check has now been discovered.

New species of artificially reared ichneumon-flies and new South American parasitic Hymenoptera form the subject of two articles, respectively by Mr. H. E. Viereck and Mr. J. C. Crawford, in the Proc. U.S. Nat. Mus. (Nos. 1789 and 1786).

It seems somewhat strange that it should be left to a Japanese naturalist to describe new cicadas from Europe and the Mediterranean countries. Nevertheless, such has been the case, and in the Journal of the College of Science of Tokio University, vol. xxvii., art. 18, Prof. S. Matsumura, who writes in German, concludes his paper on this subject, describing as new no fewer than forty-two species, together with two new genera.

In *Naturwissenschaftliche Wochenschrift* of February 5 Prof. J. Meisenheimer records the results of experiments for testing the power of regenerating their wings in insects, the moth *Lymantria dispar* being the subject of these experiments. The first traces of the wings occur as minute outgrowths from the sides of the last two limb-bearing segments of the caterpillar, and in the large series of specimens submitted to experiment these were cut away on one side. In a few instances the wings on the injured side were represented by mere knobs, but in most cases more or less well-developed wings were grown, although very generally smaller than the normal ones. Sometimes one wing on this side may be fairly well grown, and the other quite small. Details on this point, and also in regard to variation in the colour-pattern, are given in the paper.

The Entomologist's Monthly Magazine for March contains two papers—one, with a coloured plate, by Miss E. M. Alderson, and the other, by Mr. E. A. Atmore—on the beautiful little lace-wing fly, *Chrysopa dorsalis*, first added to the British list in 1900 on the evidence of specimens taken in Surrey, but subsequently found in Norfolk. The species, which frequents the needles of Scots fir, has been bred in confinement by Miss Alderson.

A synopsis of the true crabs inhabiting Monterey Bay, California, forms the subject of an article by Mr. F. M. Weymouth, issued as No. 4 of the Leland Stanford Junior University Publications. This communication, which is very fully illustrated, is to form one of a series of papers of similar scope dealing with the fauna of Monterey Bay for the purpose of rendering the local forms of invertebrates easily identifiable by the students at the Marine Biological Laboratory of the University.

The structural arrangements in the females of the decapod crustaceans of the family Peneidæ for receiving and storing the sperm are described and illustrated by Mr. E. A. Andrews in No. 1791 of the Proc. U.S. Nat. Mus. The females of this family present the comparatively rare feature of having special receptacles, or spermatotheca, for this purpose on the ventral aspect of the body, and the different degrees of complexity of these structures in the various species and genera are illustrated by sections. The alleged existence of receptacles of the same type in the females of the deep-sea prawns of the group Eryonidæ is considered by the author to be improbable.

North American parasitic copepods of the family Ergasilidæ form the subject of No. 1788 of the same serial. The family, according to Mr. C. B. Wilson, includes ten genera, three of which are described for the first time, while the definition of a fourth is revised. All its members live almost entirely on the gill-filaments or within the gill-cavities of fishes, but whereas adult females become more or less fixed, the males remain free-swimmers, and in the case of one genus do not appear to be parasitic at all. Hence males are much scarcer in collections than females, and after the breeding season can only be taken in the tow. The genera may be arranged in the three subfamilies, of which one is typically fresh water, while the other two are marine.

No. 1783 of the Proc. U.S. Nat. Mus. is devoted to the ninth portion of Mr. C. B. Wilson's memoir on North American parasitic copepods, the author dealing in this

[1] In Italy, under laws passed 1901-03, the poor and all workers have the right to receive quinine for treatment *and* prophylaxis gratuitously from the State.

instance with the family Lernæopodidæ. Special attention has been directed to the development of certain members of the family, the new facts being recorded in a summary at the end of the paper, which is too long and too technical for quotation in this place.

In No. 1785 of the serial just quoted, Mr. P. Bartsch describes several new species of molluscs of the family Vitrinellidæ from the Pacific coast of North and Central America, with illustrations of the shells.

The cyclostomatous polyzoans of the same coast are discussed by Miss A. Robertson in vol. vi., No. 12, of the University of California Zoological Publications, this communication being the third of the series. In addition to the description of new species, the author directs special attention to the ovicel, with particular reference to the investigations of Dr. S. F. Harmer.

A number of polyzoans ranging from the Ordovician to the Cretaceous, and common to Europe and North America, many of which have been included by previous writers in Stomatopora, are referred by Mr. R. S. Bassler in No. 1797 of the Proc. U.S. Nat. Mus. to a new genus under the name of Corynotrypha, for the distinctive characters of which those interested in the subject must consult the original paper.

In the Proceedings of the Royal Irish Academy, vol. xxix. (B), No. 3, Mr. A. W. Stelfox gives an annotated distributional list of the land and fresh-water molluscs of Ireland. The author acknowledges his indebtedness to Dr. Scharff in working out the fauna generally, and to Mr. B. B. Woodward for the discrimination of the species of Pisidium. Fourteen land and fifteen fresh-water species inhabiting Great Britain have not yet been recorded from Ireland, and since most of these belong to the central European fauna, there is considerable probability that they never reached the western island. On the other hand, a Hygromia which apparently belongs to the Cornish outlier of the Lusitanian fauna may turn up on the east coast of Ireland, while search for *Limax tenellus* should be made in the northern and north-western districts.

The slugs of Natal form the subject of a paper, by Mr. W. E. Collinge, published in the Annals of the Natal Museum, vol. ii., part ii. These are referable to fifteen species, arranged in six families, of which the Aperaidæ, as represented by the exclusively South African genus Apera, is new. Of the five species of this remarkable genus, which has hitherto been included in the Testacellidæ, three are found in Natal. The genus is believed by the author to represent a very primitive type, such resemblances as it shows to the Testacellidæ being probably due to parallelism. It was originally described, in 1879, as Chlamydephorus, a name which clashes with the mammalian Chlamydophorus. The author states that the latter name was given by Agassiz in 1844, but it was really proposed in 1824 by Harlan, in the form of Chlamyphorus, and this difference in the original may give rise to the question whether it really preoccupies Binney's Chlamydephorus.

No. 5 of the fifth volume of *The Philippine Journal of Science* is devoted to a description, by Mr. L. E. Griffin, of a new species of the protozoan genus Euplotes, for which the name *Eu. worcesteri* is proposed. The type-specimen was found in 1909 in water brought to the Manila Laboratory from the neighbouring bay. The species, of which exquisite illustrations are given in the plates accompanying the memoir, is very closely related to *Eu. vannus*.

A new generic type of crinoid, *Thalassocrinus pontifer*, from the Philippines is described by Mr. A. H. Clark in No. 1793 of the Proc. U.S. Nat. Mus. It is a stalked form referable to the family Hyocrinidæ, with its nearest relationship, apparently, to Gephyrocrinus.

R. L.

PAPERS ON SYSTEMATIC BOTANY.

AN important feature in the revision prepared by Dr. C. B. Robinson of Philippine Urticaceæ, is the discussion of generic limits and relationships. A new genus, Elatostematoides, is proposed for certain species previously referred to Elatostema or Pellionia, and another genus, Astrothalamus, allied to Maoutia. Under Laportea, a genus of notoriety on account of its stinging hairs, it is mentioned that the hairs are siliceous, and may contain formic and acetic acids; also that prompt relief is afforded by ammonia or carbonate of soda. Many new species are differentiated, notably nine for Laportea and twenty for Elatostema. The first part only of the article appears in the concluding number of the fifth botanical volume of *The Philippine Journal of Science*.

The second number of the current volume of *The Kew Bulletin* contains the diagnoses of thirty new African species, chiefly under the genera Protea, Sorocephalus, Loranthus, and Erythrococca, a note by Mr. G. Massee on a lilac disease, and an article on the beechwood industry of the Chilterns by Mr. W. Dallimore. The lilac disease caused by the hyphomycete, *Helminthosporium syringae*, shows first as a brown stain on either side of the leaf; the stained area extends and darkens, and olive-brown patches of fruit appear; later on, spores are formed in great abundance. Spraying with a solution of potassium sulphide in an early stage serves to check the disease. Mr. Dallimore deals more particularly with the chair-making industry centred in High Wycombe, and the brush-making industry of Chesham.

Recognising the difficulties of delineating the various species of Castilla (Castilloa), Mr. H. F. Pittier designates his careful and well-illustrated revision of the genus in the Contributions from the United States National Herbarium (vol. xiii., No. 7) a preliminary treatment, although his conclusions are based largely upon experience in the field. Ten species are distinguished, of which four from South America are placed in a separate group, while the second consists of Central American species, differing more or less from *Castilloa elastica*. The practical object of the publication is to make known the diversity of species that may be under cultivation as *C. elastica*. It is noted that *C. nicoyensis* is a good latex producer, and that *C. costaricana* is tapped by the native collectors.

A catalogue of non-herbaceous phanerogams cultivated in the Royal Botanic Garden, Calcutta, published as vol. v., No. 1, of the Records of the Botanical Survey of India, is not a mere list of species, but is designed to identify and locate every tree or shrub growing there. For this purpose the plan of the garden is divided into squares distinguished by letters and figures, and in addition each plant receives and is labelled with an individual number; thus one specimen of *Schleichera trijuga* is listed as O 10, 1641. At points corresponding to the intersection of lines posts are inserted in the garden to locate the squares. Further, a record of source and history is tabulated for each individual plant to be registered in a filed system, and special sheets have been designed for keeping note of seeds. The present index part will be supplemented by a systematic part furnishing the "stock account" of the garden.

REPORTS ON GLACIOLOGY.[1]

(1) STUDENTS of glaciology owe a debt of gratitude to M. Rabot, because information on this subject is scattered over a wide field and in unexpected places. To collect that contained in the present number of the *Revue* must have been a heavy task, and its value is increased by a careful classification. The earlier sections deal with matters such as precipitation, its form and relation to altitude, the rate at which snow melts, avalanches and their consequences, the formation of glaciers, their structures, their dates of movement, and their erosive effects, in regard to which last diverse opinions are quoted. If we can believe Prof. Hans Hess, a glacier deepens its bed by 1 metre in from thirty to fifty years, or, in other words, the erosive power of ice is at least ten times as great as that of running water. Figures are cited to support this conclusion, but a tolerable familiarity with glaciers and their works, for at least that time, leads us to suspect there is something wrong with the figures or the observations.

[1] (1) Revue de Glaciologie. No. 3 (avril 1903–1er janvier 1907). By Charles Rabot (Mémoires de la Société Fribourgeoise des Sciences Naturelles, vol. v., Band v., Géologie et Géographie). Pp. 344+30 figures. (Fribourg, Suisse, 1909.) Price 6 francs.
(2) Les Variations périodiques des Glaciers. XVme Rapport, 1909. Rédigé par Dr. E. Brückner et E. Muret. Extrait des Annales de Glaciologie, t. v. Janvier, 1911. Pp. 177—202. (Berlin: Borntrager Frères, 1911.)

Many as are the important facts from almost every part of the globe which the present number contains, it must suffice to notice only the chapter on the causes of variation in glaciers. The data there cited show that, at any rate under certain conditions, the winds are factors, especially in the removal of snow, more potent than has been hitherto supposed. In regions of low temperature, but of high winds, these drive the snow before them, like sand in the desert, and thus check the formation of glaciers. The volume of an ice-stream, speaking in general terms, is a function of two variables, the one alimentation, the other ablation. Hitherto the effect of the latter has been underestimated, the advance or retreat of a glacier having been supposed to be mainly dependent on the amount of the snow which falls on the upper part of its basin.

M. Rabot classifies the years from 1826 to 1906 in groups, according as the rainfall or the summer temperature at Geneva was above or below the average, and states that in the former case the Swiss glaciers, as a rule, retreated, and in the latter advanced. Similar, though less precise, evidence is obtained from other regions, so that it is very probable, to quote Prof. Forel's words, that the variations in summer temperature produce more effects upon glaciers than has hitherto been supposed. On the latter subject, and especially on the changes during the last few years, a very large amount of information is given. In short, its editor has made the *Revue* indispensable to all interested in the study of glaciers.

(2) The Commission Internationale des Glaciers decided at Stockholm last August that this report should appear at an earlier date. Hence a supplement will be necessary to contain documents which have not yet been received. Still, this number includes Europe, with Russian Asia and the United States of North America. The results show a general but slow decrease of the glaciers. To this rule there are local exceptions, which, however, are few except in Scandinavia; and even here they are in a minority. It is suggested that in Norway changes in the humidity of the air, due to the shifting of ocean currents, produce more effect on climate and glacial oscillation than those in temperature. Some sets of observations in the French Alps are more than usually systematic, for the investigators take account of avalanches and calculate the rate of flow and of ablation at the surface of glaciers between two stations. They note that 683 out of 740 avalanches followed a customary course, and estimate the amount of débris brought down by them at 2243 cubic metres. Altogether the number contains not a little interesting information.

THE ASSOCIATION OF ECONOMIC BIOLOGISTS.

THE tenth general meeting was held in the University of Birmingham, under the presidency of Prof. G. H. Carpenter, on April 6 and 7. There was a good attendance.

The president communicated a paper on some dipterous larvæ which last year caused considerable damage to crops of swedes near Dundalk, Ireland. These belonged to an apparently new species of gall-midge and to *Scaptomyza flaveola*. In connection with this species, several points of interest in the structure of the larva were demonstrated by means of photographs and drawings shown in the lantern.

Mr. H. Maxwell Lefroy, in a very interesting address, spoke on the training of economic entomologists. Not the least difficulty in making economic zoologists in England was the preponderance of the academic view and the total absence of the economic view based on experience. He pointed out that, in addition to a training in zoology, botany, and chemistry, a course in agriculture should be taken, and a knowledge of field work in entomology was useful.

Mr. Walter E. Collinge read a paper on house-flies and public health, in which it was pointed out that there was now no longer any doubt that cholera and typhoid fever were both spread by these insects, and that there was accumulating evidence that infantile diarrhœa, dysentery, and tuberculosis were also. Mr. Collinge contended that a proper system of control and prevention were essential on the part of every corporate body having anything to do with the health of the general public. After briefly referring to the ordinances and regulations in force in other countries, he commented upon the inadequate conditions for the keeping of food in the modern dwelling house, and the necessary regulations for the disposal and storage of manure, &c. In concluding, he pointed out that it remained with the general public to educate the authorities in these and like matters if we have to remove from our midst a danger full of potentialities to ourselves and our children, and detrimental to the public at large.

An interesting discussion on the standardisation of economic nomenclature was opened by Mr. H. Maxwell Lefroy, and a committee was appointed to deal with the matter.

Dr. G. H. Pethybridge gave an account of some recent work on diseases of the potato plant in Ireland, where the potato crop is peculiarly liable to suffer. Great advances have been made in recent years in checking the ravages of different diseases, but there are still many that have not yielded to treatment. A considerable amount of attention has been given by the author to these, and the results were very fully described and illustrated.

Mr. W. B. Grove described four little known British fungi, viz. *Mucor spinosus*, *Monilia lupuli*, n.sp., long known to brewers as occurring on spent hops, but hitherto undescribed. *Rhopalocystis nigra* was a new name proposed for *Aspergillus niger*, and *Hormodendron cladosporoides*, a species often confounded with *Cladosporium herbarum*.

Mr. Walter E. Collinge directed attention to the extremely serious nature of the plague of eelworms and white worms which are at present attacking different crops throughout the country, and to the scanty nature of our knowledge of their life-histories and bionomics. Dr. J. H. Priestley initiated a discussion on the systematic recording of diseases of economic plants. The occurrence of the beetle *Necrobia rufipes* in cotton bales formed the subject of an interesting communication by Mr. Joseph Mangan. Mr. G. E. Johnson demonstrated some stages in the life of the nematode living in the nephridia of the earthworm. The association accepted the invitation of Prof. Carpenter to meet in Dublin in 1912 at a date to be fixed later.

THE CONSERVATION OF OUR NATIONAL WATER RESOURCES.

AN interesting paper on the above subject was read by Mr. W. R. Baldwin-Wiseman before the Surveyors' Institution on January 27. This may be considered as the complement to the paper read by the author before the Royal Statistical Society in 1909 on the increase in the national consumption of water. In the earlier paper Mr. Baldwin-Wiseman dealt with the enormous increase in the consumption of water, and the reasons for such increase, and he referred very shortly to the necessity for the creation of a central authority which should be charged with the duty of water conservancy in its widest application, and, for that purpose, should engage in a close and exact study of the water resources of the country. He now deals with some of the methods adopted by different countries to conserve and use in a systematic way the water which they possess. It is rightly pointed out that the particular use of water to which greatest attention is required varies in different countries. In the United Kingdom the water supply for domestic purposes and trade uses is all-important, and with it must be coupled the prevention of stream pollution. In Italy, Switzerland, Norway, and Canada water-power development is predominant. In Egypt, India, parts of Australia, and certain regions of the United States and Canada irrigation claims first place. In Germany and Belgium inland navigation is of extreme importance, while Holland devotes attention to drainage and reclamation.

The author's researches as regards what has been done by various countries for the conservation of water for the different purposes mentioned are of a careful and exhaustive character, and it must have taken considerable time and

labour to collect this information. To all those who are engaged in water schemes perusal of the paper cannot fail to be of interest, but it will probably cause disappointment to find how little information as regards water is available in the United Kingdom in comparison with that available in some other countries.

The author concludes his paper by suggested lines of organisation in this country so as to have all matters relating to water administration under one central authority. It will probably take some time before such a complete organisation as is suggested can be attained, but there is no reason why some of the smaller suggestions should not be carried out at once. We feel sure that if the importance of the question were fully brought before the present President of the Local Government Board he would be able with very little expense and without a large supply of red tape to deal quickly with such suggestions as annual returns from all water-supply and sewage-disposal authorities, and the beginning of a hydrographic survey. If a start were once made and the importance of the matter realised, the larger details of organisation would gradually evolve themselves.

The author has added to his paper some tables dealing with the use of water in various countries, and there is also a useful bibliography. M. F.

THE COMPOSITION OF PINE WOOD.

A MONOGRAPH on the "Chemical Composition of Pine-wood," by Prof. Klason, of Stockholm, has been issued by Gebrüder Borntraeger, of Berlin, as the second of a series of "Schriften des Vereins der Zellstoff- und Papier-Chemiker." In addition to the importance of pine-wood as the chief raw material of the paper industry, this particular wood has acquired a special scientific interest from the important colour-reactions in which it has figured as a test material. Thus phloroglucinol imparts a red-violet colour to a pine splinter moistened with hydrochloric acid, aniline sulphate a yellow colour, pyrocatechol and resorcinol a red-violet, pyrogallol a grey-violet, pyrrol and indol a red, phenol a blue, α-naphthol with sulphuric acid a green, hæmatoxylin a violet, naphthylamine hydrochloride a yellow, aminoanthracene hydrochloride a red, phenylhydrazine hydrochloride a yellow, and so forth.

These reactions appear to be characteristic of a substance to which the name of "lignin" has been given; similar reactions are shown by the well-known flavouring substance "vanillin," but this is not present as such in appreciable quantities in pine-wood. Lignin is richer in carbon than cellulose, but contains the same proportion of hydrogen; it differs from cellulose in that it is not dissolved by ammoniacal copper oxide, and gives no blue coloration to zinc chloroiodide, but can be reconverted into cellulose by oxidation, and separated from it by dissolution in alkalis or by the action of sulphites, which appear to convert it into soluble sulphonates. The author has analysed the calcium sulphonate, and attributes to it the formula $C_{40}H_{44}O_{17}S_2Ca$; this corresponds with a composition $C_{40}H_{42}O_{11}$ for lignin itself, but molecular weight determinations give values above 4000. In addition to two molecules of sulphur dioxide, lignin combines with two atoms of iodine, and thus contains three double-bonds in the C_{40} complex; four methoxyl groups are present and one hydroxyl group. The substance is probably a condensation-product of coniferyl alcohol,

$$CH_3O.C_6H_3(OH).CH:CH.CH_2.OH,$$

(a substance which can be oxidised to vanillin), with an oxyconiferyl alcohol in which the substituents are grouped in the same way (1:3:4:5) as in gallic acid, thus

$$2C_{10}H_{12}O_3+2C_{10}H_{12}O_4-3H_2O=C_{40}H_{42}O_{11}.$$

Lignification appears to consist in embedding the pliable cellulose in a hard crust of lignin; by the action of a sulphite the lignin is dissolved out, and the clean cellulose which is left constitutes the paper pulp. The sulphite extracts, from which lignin can easily be recovered, might very possibly prove to be valuable raw material for the manufacture of artificial vanillin. T. M. L.

RECENT ADVANCES IN TURBINES.[1]

ON two previous occasions I have addressed this institution on the steam turbine. At the time of the first lecture, in 1900, the turbine may be described as having been in the "advanced experimental stage." Six years later it was meeting with "general acceptance" in certain fields. To-night I propose to review its progress from 1906 to the present time; but before doing so I shall, with the view of leading up to the subject, and at the risk of some repetition, briefly explain the chief features of interest, and recapitulate some of the earlier steps in its introduction.

The first turbine of which there is any record was made by Hero of Alexandria 2000 years ago, and it is probably obvious to most persons that some power can be obtained from a jet of steam either by the reaction of the jet itself, like a rocket, or by its impact on some kind of paddle-wheel. It is, however, not so obvious that an economical engine could be made on this principle. In the year 1888 Dr. de Laval, of Stockholm, undertook the problem with a considerable measure of success. He caused the steam to issue from a trumpet-shaped jet, so that the energy of expansion might be utilised in giving extra velocity to the steam. Recent experiments have shown that by such a device nearly the whole of the available potential energy in the steam is converted into kinetic energy of velocity in a straight line, the velocity attained into a vacuum being about 43,000 feet per second. Dr. de Laval caused the steam to impinge on a paddle-wheel made of the strongest steel, which was allowed to revolve at the highest speed consistent with safety, for the centrifugal forces are enormous. Unfortunately, materials are not strong enough for the purpose (in the large sizes the speed is nearly half that of a rifle bullet), and the permissible speed of the wheel can only reach to two-thirds of that necessary for good economy, as we shall presently explain.

Dr. de Laval also introduced spiral helical gearing for reducing the enormous speed of his wheel to the ordinary speeds of things to be driven, and we shall allude to this gear later as likely to play a very important part generally in future turbine developments.

In 1884, or four years previously, I dealt with the turbine problem in a different way. It seemed to me that moderate velocities were essential if the turbine motor was to receive general acceptance as a prime mover. I therefore decided to split up the fall in pressure of the steam into small fractional expansions over a large number of turbines in series so that the velocity of the steam nowhere should be great, and consequently, as we shall see later, a moderate speed of turbine suffices for the highest economy. This principle is now universally adopted in all except very small turbines, where economy is of secondary importance. This arrangement of compounding turbines also appeared to me to be surer to give a high efficiency, because the steam was caused to flow in a non-expansive manner through each individual turbine, and consequently in an analogous way to water in water turbines, where high efficiency at that date had been proved. I was also anxious to avoid the well-known cutting action of high-velocity steam on metal.

The close analogy between laws for the flow of steam and water under small differences of pressure have been confirmed by experiment, and the usual formula $=\sqrt{2gh}$, where h is the hydraulic head, gives the velocity of issue from a jet for steam with small heads and also for water, and we shall presently follow this part of the subject further in dealing with the design of turbines.

Having decided on the compound principle, it was necessary to commence with small units at first, and in spite of the compounding the speed of revolutions was still high.

Though, as we have said, the de Laval turbine appeared four years later, the de Laval cream separators were in use prior to 1884, and I had the advantage of seeing their beautiful means of balancing—the supporting of the bearings in elastic rubber sleeves, which at 6000 revolutions absorbed vibration and allowed the bowl containing the milk to rotate about its centre of gravity instead of its geometric centre. The first compound steam turbine

[1] Discourse delivered at the Royal Institution on Friday, March 10, by the Hon. C. A. Parsons, F.R.S.

ran at 18,000 revolutions, and had slightly elastic bearings. The turbine teeth or blades were like cog-wheel teeth, set at an angle and sharpened at the front edge, and the guide blades were similar. Gradually the form of the blades was improved—curved blades with thickened backs were introduced. The blades were cut off to length from brass material rolled and drawn to the required section, and inserted into a groove with soft brass packing distance pieces between and caulked up tightly, and dummy labyrynth packings of various types introduced. The design was improved so as to reduce steam leakages and provide for greater expansion ratios.

The construction of a suitable dynamo to run with the turbine involved nearly so much trouble as the turbine itself; the chief features were the adoption of very low magnetic densities in the armature core and small diameters and means to resist the great centrifugal forces. The dynamo was also mounted in elastic bearings. Now that the turbine has found its most suitable field in large powers, and the speed of revolution is consequently reduced, elasticity in the bearings is less essential, and in large land plants and in marine work rigid bearings are now universal. I have said that steam behaves like an incompressible fluid in each turbine of the series, but as it is highly elastic, its volume increases with the succession of small drops of pressure, and the turbines have to be made larger and larger. This enlargement is secured by increasing the height of blade, by increasing the diameter of the succeeding drums, and by altering the angles and openings between the blades. All three methods are generally adopted to accommodate the expanded volume of one hundredfold in the condensing turbine.

Now as to the best speed of the blades. It will be easily seen that in order to obtain so much power as possible from a given quantity of steam, each individual row of blades must work under appropriate conditions. This, as has been found by experiment, requires that the velocity of the blades relatively to the guide blades shall be about one half the velocity of the steam, or, more accurately, equal to one half the velocity of issue from rest due to the drop of pressure in guides or moving blades. The curve for efficiency in relation to the velocity ratio has a fairly flat top, so that the range of velocity ratio for high efficiency is wide, and the speed of the turbine may be varied considerably about that for maximum efficiency without materially affecting the result.

In compound turbines the efficiency of the initial rows may be generally assumed as about 65 per cent., and of the latter rows at 75 to 85 per cent., and, considering the whole turbine, approximately 75 per cent. of the energy in the steam is delivered on to the shaft. The expansion curve may be expressed approximately by $pv = \log p_1/p_2$, where $p_1 - p_2$ is the drop in pressure across any turbine; pv is obviously not quite constant, but if a mean value is assumed the error is small. The expansion curve therefore lies between the adiabatic and isothermal curves for steam, but nearer the former, and the errors in these assumptions are found by experiment to be of much less importance than the errors in workmanship and imperfections of materials that are unavoidable in practical mechanics. The differential thermal expansions of the metal of which the turbine is made are the chief reason for large working clearances and loss by leakage, though every available means is taken to mitigate such loss.

In turbine design, the expression of the velocity ratio between the steam and blades may be represented by the integral of the square of the velocity of each row through the turbine, which is a coefficient called K. If K, for instance, as usual in land turbines, equals 150,000, then we know that with a boiler pressure of 200 lb. and a good vacuum the velocity ratio is 0·55, and the turbine is working close up to its speed for maximum efficiency. In large marine work, where weight and space are of importance, K varies from 80,000 to 120,000, or even to 140,000. With K = 80,000, a loss of efficiency of about 9 per cent. below the highest attainable is accepted. With K = 120,000, the deficit is only about 1½ per cent.

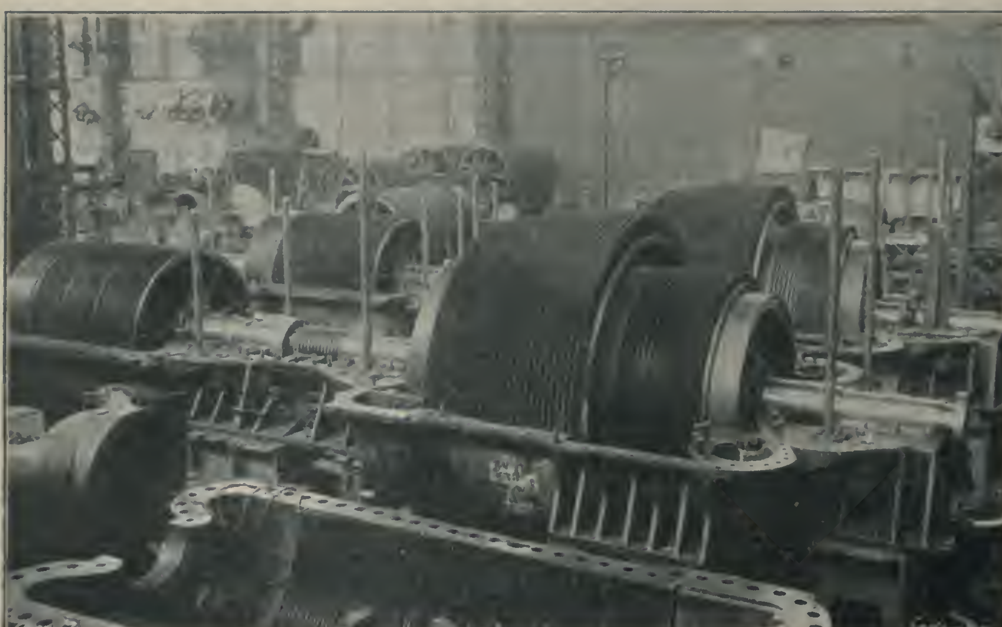


FIG. 1.—Turbines being completed. (From *Engineering*.)

There are many forms of turbines now on the market, but we need only consider four chief types, which are:—

First, the compound reaction turbine, with which we have been dealing, representing more than 90 per cent. of all marine turbines in use in the world, and about half the land turbines driving dynamos.

Secondly, the de Laval, which is only used for small powers.

Thirdly, the "multiple impulse compounded," or Curtis, which has been chiefly used on land, but which has been fitted in a few ships.

Lastly, the compound reaction type, with one or more "multiple impulse elements" added to replace the reaction blading at the high-pressure end.

We may dismiss the numerous other types as simply modifications of the original type, without any scientific interest.

Let me explain the latter types. The multiple impulse principle is the only substantial innovation since the compound reaction and the de Laval turbines came into use. It was proposed by Pilbrow in 1842, and first brought into successful operation by Curtis in 1896. A little consideration should be given to it as involving some characteristic points of difference from what has been said about reaction blading. It will be seen that Curtis used the de Laval divergent nozzle, and that he

also uses compounding, but generally only 5 to 9 stages as compared with 50 to 100 in the compound type. The same principles as regards velocity ratio apply, but owing to the repeated transfer of the steam between fixed and moving buckets at each velocity-compounded stage, the best velocity ratio in a four-row multiple impulse is only one-seventh, and the best obtainable efficiency 44 per cent., and therefore much lower than reaction blading under favourable conditions.

The good points of the multiple impulse type are that there is very little loss by leakage, and that therefore, in spite of its low efficiency, one or more multiple impulse wheels can in certain cases usefully replace reaction blading at the entry to the turbine, because in slow revolution turbines of moderate power the blades are short at the commencement, and there is consequently much loss by leakage through the clearance space. As a rule, one multiple impulse wheel is generally preferred, and is followed by reaction blading; the expansion ratio on to the wheel is about threefold, and it generates about one quarter of the whole power. Occasionally several wheels in separate chambers are placed in front of the reaction blading, but there are serious practical drawbacks to this arrangement. The multiple impulse wheel at the commencement has a further advantage in that, when highly superheated steam is used, the temperature is much reduced by expansion and work done before it passes to the main turbine casing.

The highest efficiency yet attained by land turbines has been with the pure compound reaction turbine of large size, where the high-pressure portion is contained in a separate casing of short length and great rigidity; the working clearances can then be reduced to a minimum.

The first turbine imported into Germany in 1900, of 2000 horse-power, was on this principle, and also the latest turbines, of 12,000 horse-power, which generate current for the Metropolitan Railway in London.

In marine work the same arrangement has been almost universal since 1896, when the original single turbine of the *Turbinia* was replaced by three turbines in series (on the steam) on different shafts.

Here there is the additional advantage that, owing to the power being subdivided over three shafts, smaller screws are admissible, and the speed of revolution may be increased in the ratio of 1 to $\sqrt{3}$.

Generally, the turbines are placed two in series, as in cross-Channel boats, the *Mauretania* and *Lusitania*, torpedo craft, battleships and cruisers, or sometimes three in series, as in the liner *La France* and the latest and largest Cunard liner now building. Four in series have been proposed, but not constructed.

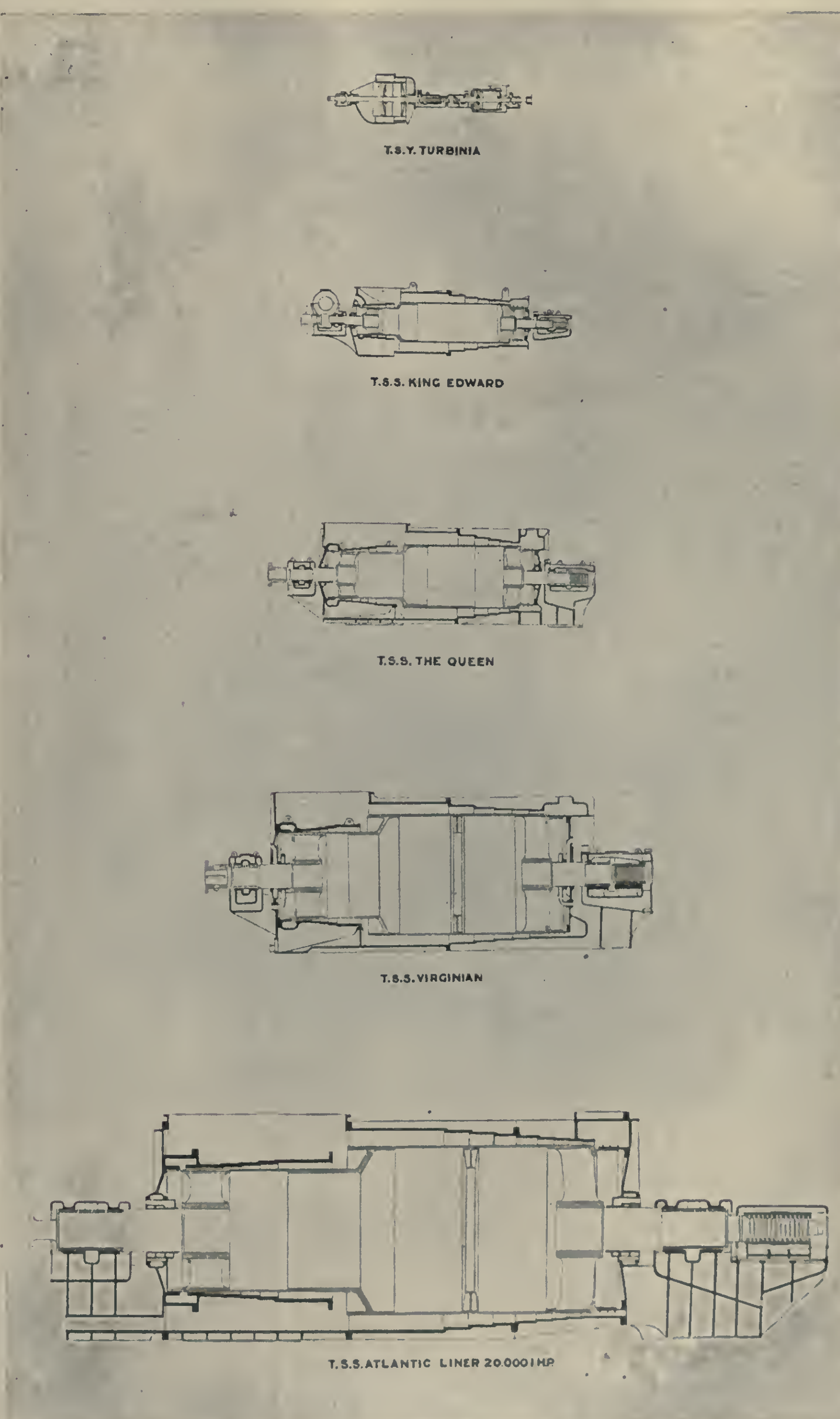


FIG. 2.—Progress in size of turbines. (From *Engineering*.)

The war vessel in commission is working at reduced

power for most of the time, and on long voyages economy of fuel is of great importance. For this purpose, additional turbines are fitted in front of the main full-power turbines. They are naturally of small size, and may be in separate casings, or the main high-pressure turbine may be lengthened by the addition of a cruising portion added on in front. All these cruising turbines or cruising elements are more or less by-passed, according as additional power is required, and at full speed they are entirely by-passed, and when in separate casings are connected to the condenser and rotate in vacuum. In some instances of modern naval construction one or more multiple impulse wheels have constituted the cruising element.

Before passing to the consideration of other applications of the turbine, I should like, with your permission, to repeat an experiment which illustrates the phenomenon of cavitation. The chief difficulty in applying the turbine to marine propulsion arose in the breaking away of the water, or the hollowing out of vacuous cavities in the water when it was attempted to force the screw above certain limits. The phenomenon was first observed by Sir John Thornycroft and Mr. Sydney Barnaby. In order to avoid cavitation, which involves great loss of power, propellers in all fast vessels are now made with very wide blades covering about two-thirds of the disc area, which gives a very wide bearing on the water, and prevents its giving way under the force.

In models, and in vessels of moderate speed, the forces are not sufficient to tear the water asunder, but if the pressure of the atmosphere is removed, a model screw will cavitate at a comparatively moderate speed.

The marine turbine, with the modifications we have so far described, is only suitable for vessels of more than 16 knots sea speed, and to make it suitable for the remaining two-thirds of the tonnage of the world has been our constant aim. The first plan to this end to be adopted is somewhat in the nature of a compromise, and is called the combination system, because the reciprocating engine is used to take the first part of the expansion and the turbine to complete it. From what we have said it will be apparent that this coalition of the reciprocating engine and turbine is a good one, because they each work under advantageous conditions. The reciprocating engine expands the steam to about atmospheric pressure, and the turbine carries on the expansion with high efficiency down to the pressure in the condenser. Now, though a large and high-speed turbine deals with the high-pressure portion of the expansion as economically as a reciprocating engine, a slow-speed turbine cannot be made to do so; but, on the other hand, a slow-speed turbine expands low-pressure steam much further and better than any reciprocating engine. In this system the turbine develops about one-third of the whole power.

About fifteen years ago I filed a patent for the system, but, with the exception of fitting the British Admiralty destroyer *Velox* in 1902, few steps were taken towards its application until the turbine had become firmly established for fast vessels, because we feared the technical public would say, "You are trying to bolster up a failure of the turbine." About three years ago Messrs. Denny, of Dumbarton, who in 1901 built the first mercantile turbine vessel, the *King Edward*, built the first combination vessel, the *Otaki*, of 9900 tons dead-weight capacity and 13 knots sea speed. She has ordinary twin screws driven by triple-expansion engines exhausting into a turbine driving a central screw. The initial pressure at the turbine is 9 lb. absolute, and it generates one-third of the whole power. The combination vessel was found to consume 12 per cent. less coal on service than her sister vessel *Orari* on the same service, fitted with quadruple reciprocating engines.

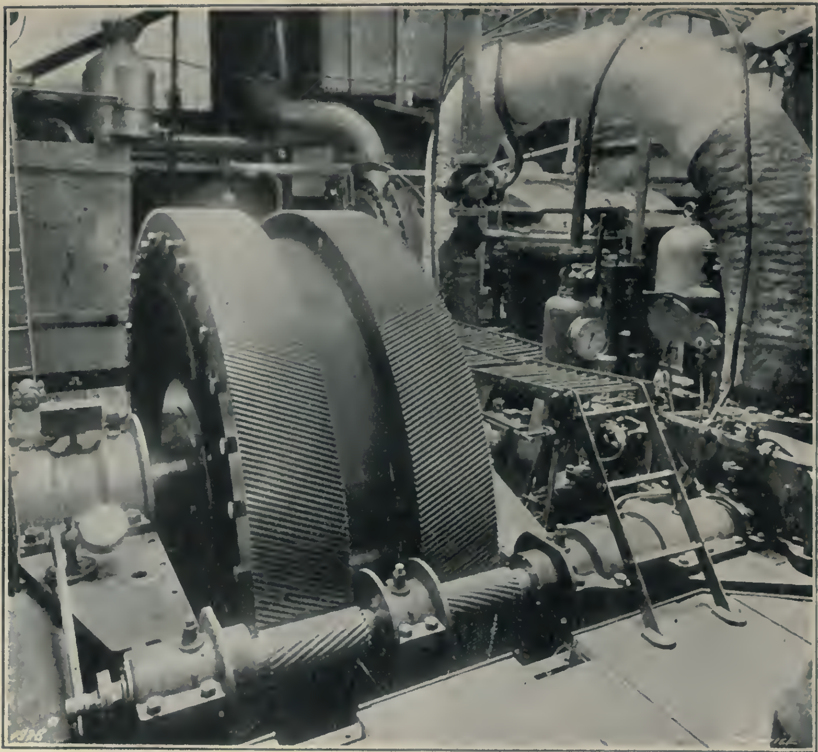


FIG. 3.—The gearing of the *Vespasian*. (From *Engineering*.)

The next combination vessel was the *Laurentic*, of 20,000 tons, built by Messrs. Harland and Wolff, a sister vessel, the *Megantic*, being fitted with quadruple engines, and on service at the same speed the saving in coal by the combination is 14 per cent.

Messrs. Harland and Wolff are also fitting the combination system in the White Star liners *Olympic* and *Titanic*, of 60,000 tons displacement, and some other companies at home and abroad are also adopting the combination system.

There is another alternative solution which promises to extend the field of the turbine further over that of the reciprocating engine. We mentioned before that de Laval had in the 'eighties introduced helical tooth gear for reducing the speed of his little turbines. For twenty-three years it has worked well on a small scale. Recent experiments, however, have led to the assurance of equal success on a large scale for the transmission of large powers of many thousand horse.

After some preliminary experiments some years ago on helical reduction gear, which showed a mechanical efficiency of more than 98 per cent., a 22-feet launch was constructed in 1897; the working speed of the turbine was 20,000 revolutions per minute, which was geared in one reduction of 14 to 1 on to the twin-screw shafting driving twin propellers at about 1400 revolutions. The speed attained was 9 miles per hour, and this little boat was many years in use as a yacht's gig.

The next step was the purchasing of a cargo boat in 1908, the *Vespasian*, of 4350 tons displacement, and triple expansion engines of 900 horse-power. After thoroughly overhauling and testing her existing machinery for coal and water consumption, the engines were replaced by

geared turbines, the propeller, shafting, and boilers remaining the same. On again testing for economy a gain of 15 per cent. was shown over the original machinery, and subsequent minor alterations have increased this gain to 22 per cent. There are two turbines, a high pressure and a low pressure, each driving a pinion at 1400 revolutions, gearing into a main wheel on the screw shaft making 70 revolutions per minute. The gearing is entirely enclosed in a casing, and is continually sprayed with oil by a pump. Ordinary centrifugal governors on the turbines control the speed, and because of the enormous angular momentum of turbines (some fifty times that of an ordinary marine engine) the acceleration is so slow that the governors have time to act, and consequently no racing has ever occurred in the heaviest weather, and it is certain that if geared turbines come into use there will be no more cases of broken screw shafting as has hitherto been common with reciprocating engines.

The vessel has now been carrying coal from the Tyne to Rotterdam for about a year, and has covered about 20,000 miles and carried 90,000 tons of coal across the North Sea. The pinion on the lecture table was specially removed from the vessel last week for this lecture, and shows a wear on the teeth of under 2/1000″ in this time, and its life will therefore be equal to or greater than that of a vessel.

Gearing promises to play an important part in war vessels for increasing the economy at cruising speeds. We explained the difficulty in obtaining good economy at the high-pressure end of marine turbines, and in replacing such portions by geared high-speed turbines we have a complete solution. The Turbinia Company are now constructing two 30-knot destroyers of 15,000 horse-power, wherein the high-pressure portion and cruising elements are geared in the ratio of 3 to 1 and 5 to 1 respectively to the main low-pressure, direct-coupled turbine. Their use will increase the radius of action of the vessels at cruising speed to a very considerable extent over that of any similar destroyer without gearing. Similar gearing is proposed for warships, with similar prospective advantages.

Gearing may also find a place in cross-Channel boats and liners for the high-pressure portion of their turbines, but the greatest material gain will be in extending the use of turbines to vessels of slow speed.

Gearing enables very high coefficients to be used in marine work at full speed, and good coefficients at all speeds without much increase in weight, and under such conditions a geared high-speed reaction turbine is much more efficient at the high-pressure end than the multiple impulse wheel or wheels we have considered, and will probably dispense with their use generally. Gearing in marine and land work promises to give to the turbine a level consumption curve like that of the gas and oil engine. Half a century ago nearly all screw vessels had mechanical gearing, one element being composed of wooden teeth, for gearing up the speed of the engine. Subsequently the speed of engines was increased, and gearing abandoned. Now a very slow-speed turbine is an impossibility, and accurately cut steel gearing seems to be a permanent and satisfactory solution.

Low-pressure turbines worked by the exhaust steam from other engines are coming into general use on land under the name of "The utilisation of exhaust steam," for they utilise what was formerly a waste product, the exhaust steam from non-condensing engines.

They are generally employed in the generation of electricity or in the working of blast-furnace blowers and centrifugal pumps and gas forcers, but recently an exhaust turbine of 750 horse-power has been applied to driving an iron plate mill in Scotland. The turbine revolves at 2000 revolutions per minute, and by a double reduction of helical gears drives the mill at 70 revolutions. A flywheel of 100 tons weight revolving at the same speed as the rolls equalises the speed. During each rolling the turbine and flywheel collectively exert 4000 horse-power, the maximum deceleration at the end of each roll being only 7 per cent.

So satisfactory has gearing proved up to the present on a small and also comparatively large scale that it seems probable that by its use turbines will be more widely adopted in the future for power purposes generally.

There are at the present time just above 6,000,000 horse-power of marine turbines completed and building, and also an equal horse-power of land turbines of the compound reaction type.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Australasian Association for the Advancement of Science held its thirteenth meeting at the Sydney University on January 9–14 inclusive. In a short article in our issue of February 23 last (vol. lxxxv., p. 558) a brief outline of the proceedings at the meeting was given. We have now received from Mr. J. H. Maiden, the permanent honorary secretary of the association, an extended account of the meetings and presidential addresses delivered in the various sections, and are glad to publish a fuller report of what proved an important and successful gathering of Australasian men of science and their friends.

The president for the year, Prof. Orme Masson, F.R.S., professor of chemistry in the University of Melbourne, presided over the meeting, which was attended by more than 500 members, the membership being above 800. Every State in the Commonwealth was represented, and also the Dominion of New Zealand.

The president gave a garden-party in the afternoon of January 9, and delivered his address in the evening in the Great Hall of the university. His Excellency the Governor, Lord Chelmsford, was in the chair.

The work of the meeting was divided among eleven main sections, each with its own president, vice-president, and secretary. The following is a list of sections with the name of the presidents :—

Section A, Astronomy, Mathematics, and Physics: Prof. T. H. Laby, professor of physics in Victoria College, Wellington, N.Z. Section B, Chemistry, Metallurgy, and Mineralogy: Prof. B. D. Steele, professor of chemistry in the University of Queensland, Brisbane. Section C, Geology: Prof. P. Marshall, professor of geology in the University of Otago, Dunedin, N.Z. Section D, Biology: Mr. F. M. Bailey, Government botanist at Brisbane. Section E, Geography and History: Prof. G. C. Henderson, professor of history in the University of Adelaide. Section F, Anthropology and Philology: Mr. Edward Tregear. Section G—two departments, (1) Social and Statistical Science: Mr. E. W. H. Fowles; (2) Agriculture: Prof. W. Angus, late director of agriculture in Adelaide. Section H, Engineering and Architecture: Mr. Ellwood Mead. Section I, Sanitary Science and Hygiene: Dr. W. Perrin Norris, Commonwealth Director of Quarantine, Melbourne. Section J, Mental Science and Education: the Rev. E. H. Sugden.

Prof. Masson spoke first of the earliest attempts to bring about a visit of the British Association to Australia. In 1909 the matter was brought under the notice of the Australasian Association, of the universities and scientific societies of Australia, and of the Federal and States Governments. All united in cordial support of the proposal, and old financial difficulties were dispelled by the far-sighted generosity of the political rulers. The Government of the Commonwealth, acting officially for all Australia, sent a formal invitation, which was unanimously accepted by the British Association for the year 1914. Prof. Masson said it was his good fortune to attend the Sheffield meeting last September, and to speak there with the High Commissioner as the inviting deputation; and he bore testimony to the hearty feeling that prevailed and to the strong desire shown by many of Britain's most distinguished men of science to profit by this opportunity of seeing Australia, to study its science on the spot, and to play a part in what will surely prove a great event in the history of imperial unity.

He went on to describe recent advances in chemistry. He dealt first with the atomic theory, and proceeded to explain with great clearness ionic dissociation, conductivity through gases, molecular collision, the periodic law, radioactivity, and the transmutation of metals. Towards the end of his address he referred to the theory of the spontaneous transformations of the atom, whereby new kinds of atom, both electrical and material, are produced, some of the latter having but a short life before they in turn

undergo spontaneous disruption like their parents. Recent as this theory of successive atomic transformation is, it may be regarded as proved; proved by mathematical analysis and quantitative observations, proved by its explanation of a host of related phenomena, proved by its successful predictions of previously unknown facts. Perhaps the most interesting thing about it is that it confirms and tends to complete the old atomic theory. The transmutation of elements is proved at last, but man has not learned to cause it; he has only learned that it has been going on in nature since the beginning. Perhaps, in utilising the intense energy of the natural radio-active transformations of radium, or its emanation, we may succeed in influencing the life-history of other, more sluggish, atoms, and thus hasten transmutations which would otherwise be so slow as to escape our observation altogether. Ramsay has done some work in this direction, and has got some curious and interesting results, but it is too early to speak with certainty of their meaning. One extension of the disintegration theory, however, seems unavoidable. The power of spontaneous disruption, involving the creation of new atoms out of old, can hardly be the exclusive property of uranium, radium, thorium, and a few other elements of large atomic weight; it must rather be an inherent property of atoms generally.

The president closed with a few remarks of local interest. "The great advances that I have sketched," he said, "are, of course, attributable in the main to European workers. Yet we may, I think, take some satisfaction in the fact that teachers and students of the universities in this part of the world, or graduates who have gone home from here, have contributed somewhat from time to time. These Australasian contributions include work on the general theory of solution, on the mobilities of ions, on electrode potentials, on conductivity in aqueous and other solutions, on the dynamics of chemical change, on gaseous ions, and on radio-active phenomena. The older universities of Australasia are growing, and new ones are arising, as in Brisbane and Perth. Naturally and inevitably there is a tendency nowadays to ask of universities a greatly increased attention to more utilitarian developments of science. It is so in England, where, for instance, the University of Sheffield devotes a great department to the metallurgy of iron and that of Leeds cultivates its schools of textile fabrics, dyeing, and domestic economy. It is so in Australia, where there is a steady pressure put upon the universities to develop increasingly on the lines of technical schools. All this is, doubtless, as it must be; but it is beset with a certain danger. The risk is that the whole energies of these institutions, where teachers are always too few, and equipment is never too plentiful, will be directed towards the useful applications of science, and science itself will be neglected. This, if it occurs, will be a pitiful result, and will not tend to raise Australia among the intellectual countries of the world. Let us be a practical people and have due regard to utility; but let us also have some means and leisure to cultivate the vastly more interesting inutilities, for thus only can we hope to increase Australasia's contribution to the true advancement of science."

The evening lectures were two in number, one on January 10, by Prof. G. C. Henderson, professor of history in the University of Adelaide, who chose for his subject the "Mutation Theory of Evolution in History." The lecturer said that from 1870 onwards evolutionary philosophy has pervaded all departments of intellectual activity, and has stimulated patient and painstaking research in all directions. Physical evolution, or evolution in the organic world, was one thing; psychical evolution, or evolution of human life and affairs, was another and very different thing. He wished, he said, to state plainly that they could not apply the current theories of organic evolution to the history of any race of human beings. Few people would care to deny that the champions of the organic theory of evolution had rendered invaluable service, not only to science, but even to religion. They had challenged and laid low many a doctrine that was little better than a superstition; they had forced religious men to discriminate more carefully between what is metaphorically and what is literally true; and they had converted many an ignorant dogmatist into an earnest and reasonable seeker after truth. But it must not be imagined that victory had been all on one side. By no means. The evidence of poetry, history, philosophy, and reasoning religion was stronger than it ever was in support of the essential differences between organic and human life. It would appear from recent pronouncements that some of the leading thinkers in the medical and biological professions are disposed to reckon with the influence of mind over body more frankly and fully than they had done hitherto.

The evening lecture on January 12 was by Prof. P. Marshall, of Dunedin, professor of geology in the University of New Zealand, who chose for his subject, "Glaciers of the Southern Alps," which was illustrated by some of the most remarkably beautiful slides that have ever been produced of a wonderful region.

The evening of January 13 was devoted to a combined conversazione given by the association and the Royal Society of New South Wales in the Great Hall of the University, when a number of exhibits were shown in the hall itself, and, in addition, the laboratories of the engineering, biological, and physics schools were thrown open. Prof. J. T. Laby exhibited a fine model of the Brennan mono-rail. During the evening the Mueller memorial medal, "for researches in natural science," was presented by the President (Prof. Masson) to Mr. Robert Etheridge, curator of the Australian Museum, in recognition of his researches in palæontology and Australian ethnography.

The following extracts from the presidential addresses in the various sections will give some idea of the wide scope of the meeting.

In Section A, Prof. Laby discoursed on "Recent Advances in Physics." It is rather interesting to find, said Prof. Laby, that physicists trained in the Australasian universities are advancing science in all parts of the world. Most of the theories and discoveries in radio-activity we owe to Prof. Rutherford (Christchurch); new views as to the conduction of electricity through gases to Prof. Wellisch (Sydney); important contributions to the theory of light by President Maclaurin (Auckland); many and varied researches in ionisation to Dr. Kleeman (Adelaide); the organisation of metallurgical research at the National Physical Laboratory, London, to Dr. Rosenhain (Melbourne); the establishment of an institution for the training of those engaged in optical industries of London to Mr. Chalmers (Sydney); of spectroscopic research to Prof. Duffield (Adelaide); while Gray (Melbourne), Lusby (Sydney), Glasson (Adelaide), Florance (New Zealand), are all contributing researches in physics from various English laboratories. It is to be hoped, he continued, that in the future an increasing amount of such investigations will be carried out in Australasian laboratories, so that these laboratories will come to be generally regarded not merely as places where existing knowledge is expounded, but where new knowledge is obtained, where there flourished an enlightening spirit of investigation. "When our laboratories come to be generally regarded in the light I have described, it can but increase their reputation in all directions and make the community have that confidence in science which is so typical of the German people, and so intimately connected with their unprecedented industrial progress."

In Section B, Prof. Bertram Steele chose for his subject "Inorganic Solvents." He said the solubility of a pure substance depends very obviously on the nature of the solvent. We thought of barium sulphate as being a most insoluble salt, being insoluble in weak or strong acid or alkaline solutions; but it should be borne in mind that all such solutions contained water, and by the substitution of pure sulphuric acid for the water it would be found that a large quantity of barium sulphate could be got into solution. Liquefied ammonia, largely used at present on the commercial scale for the manufacture of ice, was a solvent of quite unique properties, and it has been found that two classes of substances, which from the study of their reactions alone or in water solutions were classified as "acid amides" and ammonium salts, would be regarded to-day as something equivalent to the acids had they been first investigated in liquefied ammonia. All facts pointed to the conclusion that the nature of the solvent plays a most important part in conditioning the behaviour of a given substance in solution. The result of recent work in this field showed that present theories were likely to be

modified, but not discarded, by still further investigations.

In Section C, Prof. Marshall dealt with the "Basin of the Pacific Ocean." There were, he said, various theories as to its origin. It had been suggested that it was the scar left by the moon when it came away from the earth; that the hollow had been actually inherent in the pear-shaped form the earth took on cooling; and that it was a subsidence area which had existed since the Triassic period, that part of the earth's crust having fallen in owing to shrinkage. It had been supposed that a land bridge existed between New Zealand and South America not so long ago, so as to explain the resemblances between the flora and fauna of tropical South America and New Zealand. The differences of opinion as to the age and permanence of the basin were as great as those in regard to its structure. Little certainty can be got at present. Structural, rock, and depth characteristics support the idea that the real boundary of the south-west Pacific passes through New Zealand, Kermadec, Tonga, Fiji, the New Hebrides, the Solomons, and the Admiralty Islands. This supposition practically coincides with biological knowledge as to plant and animal distributions within the area. The land connections or approximation took place, he considered, in late Mesozoic or in the Pleistocene times—probably the latter. The eastern Pacific Islands are different in structure, nature, and origin from the lands on this line, and have been peopled by chance immigrants from them. The keen controversies upon all matters of interest to New Zealand geology are, however, only to be expected. The land is so isolated, and the views of geologists have been largely based upon other countries. But at the next meeting of the congress there should be more knowledge available, for there is at present a movement on foot to make an expedition to all the eastern groups of islands in the Pacific, and to gather material for a better scientific description than there has been so far.

In Section D, Mr. F. M. Bailey gave some notes on indigenous plant life. He dealt interestingly with the longevity of seeds. A great deal depends upon the climate in which the seeds are kept. Seeds near the tropics soon lose their vitality, whereas those in a drier climate retain it for a period extending in many instances over quite a number of years. Mr. Bailey pointed out that the usual method of calculating the age of a tree by the concentric rings could not be relied upon in Queensland, for in some seasons more than one might be formed, while in others one might not be made in one or more years. Reference was made to the tenacity of life among indigenous grasses—a circumstance in which Australia is unique. During certain times of drought trees have been killed, and on digging up one of the supposed dead grasses it showed not a sign of life, but with the advent of rain the whole country, in the course of a few weeks, would be waving with grass, not alone from seed, but from these supposed dead roots. Some interesting remarks were made upon "sports" in plant life, Mr. Bailey, who had had a long experience as a cultivator of plants, expressing the opinion that most of the indigenous plants termed varieties owed their variation to "sporting" rather than to sexual reproduction.

Prof. G. C. Henderson in Section E put forward a "Plea for Colonial Historical Research." The time has now arrived, he said, when the history of the Commonwealth should be undertaken in a systematic and scientific way, and the institutions through which that might be done are the universities. The historical work done in Australian centres is preparatory, and should find its fulfilment in research. The best material for research is now available, and by means of scholarships, and especially open scholarships, the right men can be found. Prof. Henderson said that the only comprehensive history of Australia that was based upon a perusal of original and trustworthy material was vitiated from beginning to end by the author's determination to prove that the aborigines were victimised by rapacious politicians and squatters.

In Section F no presidential address was delivered, as the president, Mr. E. Tregear, was at the last moment unable to leave New Zealand.

Mr. E. W. Fowles, the president of Section G1, gave an address on unemployment. From a mass of theories and discussions, said Mr. Fowles, several principles seemed to rest on solid ground. (1) Every man should be given a chance of employment—but not necessarily continual chances. (2) Sentimental treatment of unemployment is futile; the time has come for scientific handling of the problem. (3) The problem is more than local; it is national. (4) Different conditions obtaining in different countries require different remedies. (5) There is no one cure-all. The theorists who imagine a land tax or any other one reform will automatically eliminate the unemployed have been completely discredited. (6) Although there are special conditions in different localities, the same causes produce the same results the world over. Having thus stated the set principles, the president went on to say that the points still debatable were that every workman has a claim on the State to be provided with work, and that the unemployed are a necessary and permanent factor in our present industrial system. For the purpose of scientific treatment, the unemployed might be divided into two classes, those temporarily without regular employment, and those permanently without regular employment.

The relation of science to the further development of Australian agriculture was dealt with by Mr. W. Angus in Section G2. Mr. Angus commenced by showing the progress made in wheat-growing and stock production in Australia. He pointed out that between the years 1860 and 1868 the increase in area under crop was very large—larger than for the past twenty years. The average yields were quite as good, if not better, than they had been for the last eight years. The development, so far as wheat production was concerned, has been more in the direction of extending the area under crop than in any very marked increase in the yield resulting from improved methods of agriculture. He referred to the introduction of fertilisers and the use of the drill, and the great improvement they have made in the industry. He went on to point out the great need of research work to meet the special problems of this country, and dwelt upon the want of finality under the present separate State systems. Some problems are causing a loss of thousands of pounds from year to year. In the investigation of several of them really good work has been done on individual lines, but it had been left just at a stage in which it is of little practical use to anyone. He then dealt with a number of the more urgent of these problems in regard to which combined action was highly necessary. "Take-All" is rapidly spreading in Australia, and it is most desirable to do something at this stage to check it. "Bitter Pit" in apples, a disease not yet investigated, is causing great loss to the fruit industry, and requires immediate attention.

Referring to "dry-farming," he directed attention to the way the wheat areas are being extended into the country of light rainfall, and said that if the Australian farmer could grow wheat profitably in, say, more than 2,000,000 acres of land in each of the four wheat-growing States, then this is a matter which ought to be taken up without delay, and with some of the spirit and in the business-like manner that practical men and men of science are doing in America.

America has instituted a system of soil surveys, the envy of every progressive agricultural community. That work of this kind should be of value to the Australian producer must be evident to all, and what is most needed before anything is undertaken is an agreement among the States as to a definite system, so that from the commencement they might be working on similar lines.

Among other things needing attention is the work of wheat improvement by selection and cross-breeding. Then there is the investigation of such diseases as "Dry Bible" and red rust in wheat, and the raising of varieties immune from attack. There is also the question of strength in flour, and the fixing of a uniform method of determining same, the process of nitrification under Australian conditions, the arrangement of a more uniform system of experimental work, and the comparison and publication of results, investigation into the quality and composition of surface and artesian waters as regards their suitability or otherwise for irrigation.

What is wanted is not a Royal Commission to report, but a body of trained workers to tackle the matter on

systematic lines. Such action has been taken by organisations similar to theirs—for example, the Agricultural Education Association of Great Britain and the Breeders' Association of America. The opportunity seems a good one for the Australasian Association to associate itself with questions of practical importance to the agricultural industry.

Agriculture has to run upon more scientific lines, and the farmer must be even more of a trained producer than in the past. There must be a change in the relations of the man of science and the farmer. They must become more and more co-workers, and have many more interests in common. Hence there must be some half-way meeting-place, and he could think of no more suitable institution than the experimental farm properly equipped and rightly conducted. These farms should be controlled by trained men. They should also be properly equipped—laboratories, workrooms, special implements, and special conveniences. Mr. Angus suggested the establishment of a Central Research Station on the lines of the great institution at Rothamsted. Failing that, the establishment of a Federal Research Station, properly equipped and staffed by the very best men the Commonwealth could provide, would meet the case.

In Section H, dealing with engineering and architecture, Mr. Elwood Mead, chairman of the Victorian State Rivers and Water Supply Commission, submitted a paper on the conservation of water in Australia. In two-thirds of this continent, said Mr. Mead, it is doubtful, seeing that the average annual rainfall is less than 20 inches, whether, with the most economical usage, enough water can be conserved to permit of all the land being occupied or all the mines worked, and it is certain that wasteful or improvident use will mean that large areas of fertile and fruitful soil must for ever remain barren. The Commonwealth Government should, he said, move in the matter, and if that is not feasible, then there should be concerted action by the States. Among the questions this investigation would deal with were the source, the extent, and the probable permanency of underground supplies. In Queensland alone the wells which tap this underground reservoir have a length of more than 310 miles, and had cost above 2,000,000*l*. Nearly 2000 bores had been sunk there. Prof. Gregory had estimated that in 1903 the wells of New South Wales discharged about 22,000,000 cubic feet a day, and those of Queensland 63,000,000 cubic feet. Since that time the number of wells and the discharge had increased. Much of this water is wasted, the prevailing practice being to allow the water forced to the surface to escape. Consequently there is loss by soakage and evaporation. Seriously, Australia should consider whether it is wise to allow this waste to continue.

That the supply is not unlimited, said Mr. Mead, need not be argued. Not only is it limited, but it is less than will be needed for domestic and stock purposes alone. Artesian supplies could not be expected to provide for it. Just how limited the supply was, and how long the flow would continue, were the vital questions. Should the conclusions of Prof. Gregory be correct, the exhaustion of Australia's underground reservoir was inevitable, and it would go out like a snuffed candle.

The presidential address in Section I was delivered by Dr. W. P. Norris, Commonwealth Director of Quarantine, on "Public Health Ideals." Dr. Norris quoted some striking examples of disasters brought about by man's blind dealings with nature. But this rashness, this capacity for experiment and adventure, is the very essence of progress; and, finding he has suffered, man has sought to know more of the world in which he is placed that he may save himself. As his knowledge gathers in volume and becomes precise and ordered, so the beginnings of sanitary science are reached. Man has already furthered his own evolution considerably, half-unconsciously, and for his personal advantage. Science seeks to discover the all-powerful, the all-mighty, the abiding, the permanent, the eternal, in and behind things. There can be little doubt but that to-day man is within reach of real and abiding knowledge, and that if he but has the will, the earnestness, and high seriousness necessary, he may enter into his kingdom—the Regnum Hominis of which Bacon believed, and of which Ray Lankester has more recently told in his Romanes lecture. Science urges the deliberate assumption of his kingdom by man as an absolute duty, in order that he may make good his position in the kingdom of living things, and avoid the holocausts of the past.

The presidential address in Section J, mental science and education, was delivered by the Rev. E. H. Sugden, who spoke of music as an instrument of education.

The principal resolutions passed by the council of the association were the following:—

Magnetic Observatories.—"In view of the great scientific importance of continuous magnetic observations at selected stations, the council most strongly urges the establishment of magnetic observatories at Perth and Port Darwin, to supplement the long-continued and extremely valuable magnetic work of the Melbourne Observatory. The council learns with gratification that the reduction of the forty years' observations of the Melbourne Observatory is now completed, and would earnestly request that the Victorian Government authorise the printing of the results." The foregoing resolution to be brought to the notice of the Commonwealth, Victorian, and Western Australian Governments.

Seismological Equipment.—"That the council directs the attention of the Governments of Western Australia, South Australia, New South Wales, and Victoria to the desirability of increasing and improving the seismological equipment of their respective observatories, in order to fulfil such modern requirements as are represented, for example, in the first-order seismological station in the St. Ignatius College Observatory at Riverview."

Physical and Chemical Data.—"That a committee, consisting of Prof. Masson, Prof. Warren, Prof. Laby, and Dr. Love as secretary, be appointed to cooperate with the International Commission for the collection and annual publication of all determinations of physical, chemical, crystallographic, and engineering constants, and that a sum of 25*l*. be granted towards the work of the committee."

Meridian Observatory.—"That the Australasian Association for the Advancement of Science respectfully directs the attention of the Government to the following resolution, which was passed at the International Astrographic Conference held in Paris in 1909. This resolution the association most strongly supports." Resolution referred to:—"Considering the very small number of observatories in the southern hemisphere organised for work of high fundamental precision, it is very desirable in the interests of science that a meridian instrument of the most modern type should be installed in Australia."

Teaching of Elementary Geometry.—"That, pursuant to the provisions of the resolution carried in Brisbane with regard to the teaching of elementary geometry, a committee, consisting of Prof. Carslaw, Mr. Lucas, Mr. R. H. Roe, with Mr. P. Board as secretary, with power to add to their number, be appointed to carry out the instruction contained in the last half of the Brisbane resolution."

Yass-Canberra Observatory.—"That the council of the A.S. express its gratification of the action taken by the Commonwealth Government in regard to the creation of an observatory at Yass-Canberra, and would recommend that in order to comply with the request of the International Union for Solar Research, brought before the council at the Brisbane meeting in January, 1909, such observatory be designed to fill, amongst other requirements, those of a solar observatory."

Australian History.—"That in the opinion of this association it is desirable that the governing bodies of the public libraries in Sydney, Melbourne, Adelaide, Brisbane, Perth, and Hobart, should communicate with the Secretary of State for the Colonies, asking that duplicates of the despatches that passed between the Governors of the colonies and the Secretaries of State up to a date fixed upon by the Secretary of State should be placed under their charge, and that a copy of this resolution be forwarded to the secretary of each of the libraries aforementioned."

Australian Aborigines.—"That the general council be requested to communicate with the State Premiers, directing their attention to the advisability of adopting a uniform method of spelling Australian place-names."

"That the system of orthography for native names of

places adopted by the council of the Royal Geographical Society, the Foreign and Colonial Office, the Admiralty, and the War Office be used."

"That an organised scheme for the future of the Australian aborigines be formulated and submitted for the consideration of the Federal and State Governments, and that the following be a committee to collect evidence, draw up and submit a proposed scheme to aid these authorities in the event of their consenting to take up the question, and that such scheme receive the support of the association:—Prof. J. Wilson, Dr. Norris, Prof. Baldwin Spencer, Prof. Stirling (Adelaide), Mr. Gillen, Rev. Dr. G. Brown, Archdeacon Lefroy, Dr. Cleland, with power to add to their number."

Anthropometric Tests.—"(1) This section recommends that all anthropometric measurements under the control of the Australasian Governments be based on the schedule of the British Anthropometric Committee. (2) That the advantage of utilising for this purpose the existing machinery for medical inspection of school children in the various States, and of the compulsory cadet service of the Commonwealth, be urged on the authorities concerned. (3) That a committee, consisting of Profs. Masson, Lyle, and Osborne, Drs. Norris and Harvey Sutton, Mr. Tate, Colonel Watson, and the Public Works Architect, be appointed to investigate the subject of ventilation in buildings, and that the committee be asked to present a report to the next meeting (Melbourne)."

General Recommendation.—"That the president of the association be requested to communicate with the Prime Minister of the Dominion of New Zealand, and place before him the desirability of proceeding with the work of describing and publishing the results of the examination of the collection of fossils made by the officers of the Geological Survey of New Zealand, and deposited in the Dominion Museum, Wellington."

"That it is important in the interests of higher education that additional university teaching should be provided in the department of philosophy, more especially in the subjects of sociology and experimental psychology."

"That a time limit be set for authors of papers read before the association, which shall not be exceeded except by special arrangement made beforehand with the sectional committee."

"That a general discussion on 'The Eucalypts and their Products' be brought forward at the Melbourne meeting."

Geophysical Observatory at Barren Jack.—The sum of 50*l.* was voted to assist in defraying the expense of establishing a geophysical observatory near Barren Jack reservoir, for the purpose of attempting to measure the amount of earth tilt under load.

Survey Work around New Zealand.—"That, in the opinion of the Australasian Association, the investigation of the continental shelf around New Zealand and the islands of the south of New Zealand is a work of pressing necessity, both for scientific and for economic reasons; and the association, while recognising the value of the work already done in this direction, would urge upon the New Zealand Government the desirability of taking advantage of the facilities offered by the stay of the Antarctic exploring ship, *Terra Nova*, in New Zealand to complete the survey of the surrounding seas by soundings and dredgings as far as possible."

Protection of Forests.—"That, in view of the vital importance of the conservation of water in Australia by the protection of forests and timber around the sources of its rivers and streams, and which was to have been considered at the present congress, but was deferred until the next meeting in Melbourne, by resolution carried last Monday, it is advisable that a special committee be now appointed to deal with the question in the meantime, and also bring it to the notice of the several Governments of the Commonwealth, in order to prepare the way for a more successful result when dealing with the matter at the Melbourne meeting."

Geological Committees.—(1) A committee to inquire into the question of the classification of the Permo-Carboniferous of Australia, with a view to the revision of the nomenclature. (2) A committee for recording structural features in Australia. (3) A committee to investigate and report on the glacial phenomena in Australasia. (4) A committee to investigate questions of quaternary climate in Australasia. (5) A committee for the investigation of the alkaline rocks of Australasia.

Tidal Survey.—"The Australasian Association for the Advancement of Science at its Sydney meeting in 1911 views with satisfaction the successful establishment by the New Zealand Government of the Tidal Survey, and trusts that at many of the outlying islands automatic tide gauges may be established, and the results systematically analysed. It directs that a copy of this resolution be forwarded to the Prime Minister of New Zealand."

Scientific Literature.—"That a committee be appointed to consider the steps which should be taken with a view to the compilation of a list, as complete as possible, of the scientific serial periodical literature, both in public and private possession in each of the principal centres of Australia."

The council passed the following resolutions with regard to Antarctic exploration:—"This committee recommends that the sum of 1000*l.* be paid from the funds of the association towards the expenses of the proposed Antarctic expedition, on the following conditions:—

"(1) That the expedition be under the supreme command of Dr. Mawson, free from control by any authority outside Australia.

"(2) That the details of the scientific work and the appointment of the members of the expedition be placed in the hands of a special committee of the association, such committee to have full power, subject to the approval of the leader of the expedition. But this condition shall be open to modification after consultation with the Commonwealth Government.

"(3) That Sir E. Shackleton's full consent to the first condition be first obtained.

"(4) That the sum subscribed be spent upon instruments, which shall become the property of the association on the conclusion of the expedition."

The Governor, Lord Chelmsford, gave a garden-party at Government House, Rose Bay. The association received similar hospitality from Miss Macdonald, principal of the Women's College.

The president of St. Ignatius College, Riverview, invited the members of Sections A and C to visit the college to inspect the fine seismological observatory installed at the college. Other invitations were received from various engineering departments of the State. Dr. Harvey Sutton, of Melbourne, gave a demonstration showing how to make and to throw boomerangs.

Prof. T. W. Edgeworth David was unanimously elected president for the next meeting of the association, which will be held in Melbourne in 1913.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The thirty-eighth annual dinner of the old students of the Royal School of Mines will be held on Thursday, May 4, at the Café Monico, Piccadilly Circus, W. The chair will be taken by Sir Thomas H. Holland, K.C.S.I., F.R.S. Tickets may be obtained from the hon. secretary, Mr. Arthur C. Claudet, 6 and 7 Coleman Street, London, E.C.

On Tuesday, April 25, at 10 a.m., Mr. Clifford Dobell will commence a series of twenty lectures on the structure and life-history of the Protista (Protozoa and Protophyta) in the zoological department of the Imperial College of Science. The lectures will be given on Tuesdays and Thursdays at 10 a.m., and will be followed by practical work on Wednesday, April 26, at 5 p.m. Prof. E. W. MacBride, F.R.S., will begin a course of sixteen lectures on "Experimental Embryology." These lectures will be given on Wednesdays and Fridays at 5 p.m., in the zoological department of the Imperial College. Practical work in connection with the lectures will be given twice a week, at times to be arranged. Both Prof. MacBride's and Mr. Dobell's lectures are free to the public.

In *The School Review* for April a report appears of a lecture by the superintendent of schools at Munich, Dr.

Kerschensteiner, in which he describes the compulsory continuation schools of that city, where more than 90 per cent. of the children between the ages of six and eighteen are in attendance at one class or other of public school, and where the pupils in the compulsory continuation schools average 330 hours per annum of attendance. These schools are of two kinds, a highly organised kind for youths between the ages of fourteen and eighteen during their apprenticeship, at which they receive instruction in specific relation to their trades, and a continuation school for girls, at which three years' attendance is compulsory subsequent to the close of the primary-school career at the age of thirteen. The boys' schools cater specifically for every trade in which there are twenty-five apprentices, and there are fifty-two special trade schools as well as twelve general schools. The girls' course of instruction, at present, deals almost exclusively with domestic matters, but attention will be devoted to industrial affairs as the scheme is thoroughly developed. "The only path to real State-community," remarks Dr. Kerschensteiner, "is to accustom the children from their earliest years to do their work, not only for their own personal advantage, but also for the advantage of their youthful companions. Only thus can we hope to develop the two great fundamental virtues of devotion to aims outside ourselves and of consideration for the interests of others. And only thus will it in all probability be possible to preserve our great modern constitutional States from the dangers which threaten them through their own industrial, economic, social, and political development."

At the afternoon sessions of the forthcoming Imperial Education Conference, which will be held on April 25–28 inclusive, the following papers will be read and followed by discussion:—Tuesday, April 25: Mr. H. J. Mackinder, M.P., the teaching of geography from an imperial point of view, and the use which could and should be made of visual instruction; Prof. H. E. Egerton, some aspects of the teaching of imperial history. Wednesday, April 26: Mr. Marshall Jackman, experimental work in the teaching of arithmetic in elementary schools; Mr. J. G. Legge, practical education in elementary schools; Mr. J. Strong, secondary education in Scotland. Thursday, April 27: Dr. J. A. Ewing, C.B., F.R.S., engineering education; Mr. J. H. Reynolds, higher technical instruction. Friday, April 28: Mr. R. Blair, trade schools; Mr. Graham Balfour, continuation schools. These sessions will be held at the Foreign Office, and persons who have special knowledge of, or interest in, the various subjects which are to be dealt with at each particular session have been invited, but in view of the small space available the number of invitations has had to be strictly limited.

The London County Council has recently decided to make a maintenance grant of 8000*l.* to the Imperial College of Science and Technology, South Kensington, S.W. In return for this grant it secures the privilege of nominating twenty-five students for one year's free instruction at the Imperial College. These places are to be filled as from October, 1911. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the administrative county of London, and must be students at an institution aided, maintained, or approved by the Council, for this purpose, who have attended regularly courses of instruction for at least two sessions. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Application forms (T. 2/268) can be obtained from the Education Officer, London County Council, Victoria Embankment, London, W.C., and must be returned not later than Saturday, May 27, 1911.

The summer field session for 1911 of the School of American Archæology, of the Archæological Institute of America, will be held at El Rito de los Frijoles, near Santa Fé, New Mexico. Facilities will be given students to observe or to participate in the excavations, begun in 1908, and now in progress at Tyuonyi, near by talus pueblos and cliff-dwellings. Excursions will be made to facilitate a study of botanical and other environmental conditions of the tribes dwelling in the vicinity. During August, lectures will be given on the distribution and culture of the tribes in the south-western section of the United States; on the evolution of design as shown in ancient Pueblo art; on the native languages, and methods of recording them. A course will be given by Dr. Lewis B. Paton, formerly director of the American School in Jerusalem of the Archæological Institute of America, on "The Ancient Semites," to afford an opportunity of a comparative study of cultures developed in semi-arid regions in the eastern and in the western continents. The object of the annual summer field session of the School of American Archæology is to bring together persons interested in the study of anthropology, for investigation and discussion, and to give students the opportunity for field work needed to supplement university instruction. At the close of the session opportunity will be given to visit the pueblos of Taos and Acoma, and the Government excavations among the cliff-dwellings in the Mesa Verde National Park, Colorado. Details of the summer session may be obtained from the Director of the School of American Archæology, Santa Fé, New Mexico.

The council of the Teachers' Guild has addressed a letter to the Board of Education on the subject of cooperation between labour exchanges and local education authorities, approving the principle of such cooperation, provided that the employment of juveniles be primarily considered from the point of view of their educational interests and permanent careers. The guild recommends that the subcommittees to be appointed for this work should include county councillors, H.M. inspector and council inspectors, directors of technical and continuation classes, representative employers and workmen, and representatives of the head teachers, of the school managers, and of the care committees (where they exist). The central offices for this work should be located within, and form part of, the offices of the local education authority, and from age fourteen to seventeen the "juveniles" should be, to some extent, under the supervision of the education officers of the county authority. The letter points out the important results which may flow from the adoption by local authorities of the powers offered to them by the Education (Choice of Employment) Act, 1910. We quote the following passages, which summarise views frequently expressed in Nature:—"In the past the lack of adequate linkage between the work of the ordinary schools and that of technical classes has been felt to be a most serious hindrance to technical education. The removal of this hindrance is desirable, but of greater future importance is the opportunity for systematic schemes for the continued education of boys and girls *directly after they have left school*. . . . The experience of teachers, and of those engaged in research into mental development, points to the enormous importance of the period between fourteen and seventeen years. . . . The work of ordinary elementary and secondary schools should be in closer touch with everyday life. . . . Some of the work of continued education should be done in day schools. The cooperation of employers is essential."

Forty-one annual conferences of the National Union of Teachers have been presided over by men whose addresses have received and deserved considerable public attention. This year, for the first time, a woman took the presidential chair, and special interest therefore attaches to her speech. We recognise in Miss Cleghorn's address a womanly regard and sympathy for the children, which in no wise detracts from the breadth of view evinced by her chairmanly utterance. Dealing first with the infants' departments, she deprecated the exclusion of young children under five when home conditions do not permit adequate maternal care and training. Again, it is a disastrous policy to promote children to the older depart-

ments before they are fit, as is frequently done for the sake of higher grants. For the lower standards in the boys' and girls' departments she claimed more freedom, more activity, a better bridge from the infants' school. She asked that in the ordinary schools there should be a later leaving age, a more suitable curriculum, smaller classes, better attendance. All education up to twelve should be primary in name and practice. The transition to secondary schools should be easy for all scholars about the age of twelve years, and secondary schools of varying types should provide the coping-stone of primary education. Miss Cleghorn pleaded for the abolition of half-time, for a more vocational bias in the work of the present secondary schools, and for the extension to England of the powers already granted to Scotland of enforcing attendance at continuation schools until the age of seventeen years.

AMONG other matters of wide interest which were brought before the National Union of Teachers at the Aberystwyth conference we note especially the careful statement of the difficulties attending ameliorative medical work, contributed by Dr. Lewis Williams, the Bradford medical superintendent. At the Bradford school clinic 6446 cases were dealt with during last year, of which 3520 have actually received treatment, and of these 3000 have been cured of disease, had vision corrected, or teeth attended to. It is impossible to read this paper without arriving at the conclusion that the school clinic is a valuable—even a necessary—institution, and that the case for the extension of school clinics has an appalling strength. In view of recent controversies, it was inevitable that keen interest should be shown in the subject of a paper by Mr. T. P. Sykes, "Function and Position of H.M. Inspectors of Schools in the Elementary-school System," read at the same conference. The paper was evidently written before the recent Parliamentary discussion, and its main purpose was to put forward a view of the duties of the inspectorate which is very different from the one which appears to prevail. Mr. Sykes would wish inspectors to devote their energies to securing proper conditions of work, involving adequate expenditure and administration. They should see that the Medical Inspection and the Child Feeding Acts are properly carried out, that schools are not overcrowded, that there are proper staffs of certified teachers, that salaries are such as to secure efficiency. As a professional teacher, Mr. Sykes protested against the present system of interference by inspectors with methods of teaching, and he gave instances of its deleterious effect. Mr. Sykes did not, however, suggest any method of testing the efficiency of the work.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, April 5.—Dr. C. W. Andrews, F.R.S., vice-president, in the chair.—E. S. **Cobbold**: Trilobites from the Paradoxides beds of Comley (Shropshire), with notes on some of the associated brachiopoda by Dr. C. A. Matley. The author describes and illustrates the type-specimens of *Paradoxides groomii*, Lapworth, 1891, and the associated trilobites from the basement beds of the Middle Cambrian of Comley Quarry. Among the latter there are two or three other species of Paradoxides, represented by fragments insufficient for specific determination; also a species of Dorypyge, allied to *D. oriens*, Grönwall, and one of Conocoryphe allied to *C. emarginata*, Linnarsson. He also describes some of the trilobites from a higher horizon containing *Paradoxides davidis*, Salter, and *P. rugulosus*, Corda; and notes on the brachiopoda from this horizon are contributed by Dr. Matley. A complete list of the trilobites hitherto identified from the local Cambrian deposits is given.—Dr. D. **Woolacott**: The stratigraphy and tectonics of the Permian of Durham (northern area). The Permian strata of Durham and Northumberland lie unconformably on a basin of the Coal Measures; they may be divided into:—(4) upper red beds with salt and thin fossiliferous Magnesian Limestones (only exposed in the south of Durham), 300 feet; (3) the Magnesian Limestone; (2) the Marl Slate, 3 feet; (1) the Yellow Sands, from 0 to 150 feet. These beds, which vary much in thickness, lie in North Durham in the general form of a syncline beneath Sunderland. The unfossiliferous Yellow Sands are probably a deltaic formation reassorted by wind, the other beds being the result of deposition in an inland sea undergoing desiccation. The magnesium carbonate existed in the waters of the sea, and was either deposited along with the calcium carbonate or introduced by seepage when the beds were being laid down. Great changes in the amount and distribution of these carbonates have, however, taken place since deposition. The percentage of calcium carbonate is sometimes more than 99, while that of magnesium carbonate is occasionally as much as 50. The fauna of the Magnesian Limestone is very restricted (about 140 species) and most peculiarly distributed. The marked palæontological features are the profusion of individuals in the Middle Fossiliferous Limestone (which appears to have formed a shell-bank in the Middle Magnesian-Limestone sea), and their sudden disappearance in the Upper Limestone. No corals, echinoderms, polyzoa, brachiopods, or cephalopods have ever been found above the top of the Middle Fossiliferous division, only a few fishes, gastropods, lamellibranchs, entomostraca, and foraminifera occurring in the Upper beds. The Lower and Middle Fossiliferous Limestones are marked by the presence of *Productus horridus*, Sow. Fish-remains occur at two horizons, namely, the Marl Slate and the Flexible Limestone, and the beds above these deposits. The Brecciated beds, which occur at various horizons, chiefly, however, in the two Middle divisions, constitute the most marked tectonic feature of the Magnesian Limestone of the area. They have been produced by thrusting, which brought about a decrease in the lateral extension of the Permian. Associated with the breccias are other proofs of thrusting:—(1) thrust or shear-planes; (2) disturbed and displaced masses of Lower Limestone; (3) intruded breccias; (4) slickensided and grooved, horizontal and vertical surfaces; (5) cleavage; (6) folding, both on a local and on a general scale; (7) buckling, thickening, and squeezing-out of beds; (8) phacoidal and other structures; and (9) fissuring.

DUBLIN.

Royal Dublin Society, March 28.—Mr. R. Lloyd Praeger in the chair.—Prof. T. **Johnson**: (1) *Archaeopteris simplex*, sp.nov.: (2) Is Archæopteris, Dawson, a pteridosperm? The author gave an account of his examination of specimens of Archæopteris, Daws., in the botanical division of the National Museum, and in the Royal College of Science, Dublin. He recorded in the first part of his paper the occurrence in the south of Ireland, in the Upper Devonian beds, of *A. hibernica*, var. *minor*, Crépin, *A. roemeriana*, Göpp., and *A. Tchermaki*, Stur, in a fertile state. In the second part of the paper certain features in the structure of *A. hibernica*, Forbes, sp., are described. The more interesting features are the presence of fertile adaxial and sterile abaxial lobes in the fertile pinnule or *sporophyllule*, the vascularity of the stalk of the sporangium, and the transverse septation of the latter. The paper concludes with a discussion of the relationship of Archæopteris to the Ophioglossaceæ, the Sphenophyllaceæ, and the Pteridospermeæ.—Dr. J. H. **Pollok**: The vacuum-tube spectra of the vapours of some metals and metallic chlorides. The author showed reproductions of the spectra of the metals or chlorides of thallium, lead, copper, bismuth, iron, aluminium, chromium, manganese, nickel, cobalt, barium, strontium, calcium, magnesium, potassium, sodium, and lithium taken by means of his new quartz vacuum tube. As observed in the spectra referred to in part i. of this paper, there is invariably a marked difference between the spectra taken without a condenser and with a condenser in the secondary circuit. In the former case bands show a greater tendency to develop, in the latter there are invariably many more lines, but some become weaker. The new lines, and lines that become stronger, are very generally those showing the discontinuous lines when metallic electrodes are sparked in air, and a spherical condenser is used in photographing.

Royal Irish Academy, April 10.—Rev. J. P. Mahaffy, president, in the chair.—Major **Berry**: The Sierra Leone cannibals, with notes on their history, religion, and customs. Traces of a formerly richer flora and the remains of human settlements would tend to prove that the Sahara was subject to cyclical periods of aridity and humidity, and that in Palæographical times it possessed a climate favourable to life. It was in the Sahara that the Mediterranean race probably originated and sent forth waves of migration, one of which, moving southwards, pushed the blacks back to the unhealthy coast-line. These blacks were by the Arab historians called the Dem-Dem, and are now known as the Mampas. Formerly they must have been powerful, but are now broken up along the coast from the Gambia to the Niger. From time immemorial these people have practised cannibalism, less for food than as a sacrament, with definite ritual curiously resembling that of ancient Mexico and Egypt. There are traces of a Mother Goddess, and the symbology connected with their religion and customs suggests other than local origins. Details of the customs and cannibalistic ritual collected in the country by the author are given and discussed.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1911, contains the following memoirs communicated to the society:—

November 16, 1910.—E. **Kohlschütter**: The structure of the earth's crust in German East Africa.

January 14, 1911.—W. **Voigt**: Contributions to Lord Rayleigh's theory of grating-inflexion.

December 10, 1910.—N. **Galli** and K. **Försterling**: Theoretical and experimental researches on the optical behaviour of minimal metallic films.

November 26, 1910, and January 28, 1911.—W. **Voigt**, with a note by H. A. **Lorentz**: General considerations on emission and absorption in connection with the question of measurements of intensity in the Zeeman effect.

DIARY OF SOCIETIES.

THURSDAY, April 20.

Society of Dyers and Colourists, at 8.—The Dyeing of Paper Pulp: R. Bickerstaffe.

MONDAY, April 24.

Illuminating Engineering Society, at 8.—The Ratio of Light to Illumination: Haydn T. Harrison.—Some Notes on the Effect of Wall-papers upon the Illumination of Interiors: P. J. Waldram.

Victoria Institute, at 4.30.—The Sidereal Universe: Sir David Gill, K.C.B., F.R.S.

TUESDAY, April 25.

Royal Anthropological Institute, at 8.15.—River Life and People in Upper India: P. B. Bramley.

Royal Statistical Society, at 5.—The Application of the Method of Multiple Correlation to the Estimation of Post-censal Populations: E. C. Snow.

WEDNESDAY, April 26.

Royal Society of Arts, at 8.—The Production and Identification of Imitation and Artificial Gems: Noel Heaton.

Geological Society, at 8.—The Llandovery and Associated Rocks of North-eastern Montgomeryshire: A. Wade.—Geology of Northern Nigeria: Dr. J. D. Falconer.

British Astronomical Association, at 5.

THURSDAY, April 27.

Royal Society of Arts, at 4.30.—The Trend of Mineral Development in India: Sir Thomas Henry Holland, K.C.I.E., F.R.S.

Royal Institution, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

Mathematical Society, at 5.30.—On the Geometry of a Deformable Octahedron: G. T. Bennett.—A Symmetrical Method of Apolarly Generating Cubic Curves: W. P. Milne.—The Solution of the Homogeneous Linear Difference Equation of the Second Order (Second Paper): G. N. Watson.—A Cartesian Theory of Complex Geometrical Elements of Space: G. B. Mathews.—The Number of Primes of given Linear Form: Lieut.-Col. A. Cunningham.—On the Proofs of the Properties of Riemann's Surfaces discovered by Lüroth and Clebsch: Prof. M. J. M. Hill.

Institution of Electrical Engineers, at 8.—Battery Economics and Battery Discharge Arrangements: A. M. Taylor.

FRIDAY, April 28.

Royal Institution, at 9.—The Revolutions of Civilisation: Prof. W. M. Flinders Petrie, F.R.S.

Physical Society, at 5.—High-tension Electrostatic Wattmeters: Prof. Ernest Wilson.—Previous Magnetic History as Affected by Temperature: Prof. Ernest Wilson and L. C. Budd.—Note on the Behaviour of Incandescent Lime Kathodes: Dr. R. S. Willows and T. Picton.—On the Formation of Dust Striations by an Electric Spark: Dr. S. Mars[illegible] and W. H. Nottage.

Institution of Mechanical Engineers, at 8.—Gas-producers: J. Emerson Dowson.—The Effect of Varying Proportions of Air and Steam on a Gas-producer: E. A. Allcut.

Institution of Civil Engineers, at 8.—The Commercial and Technical Relations of Engineering Design and Work: T. Frame Thomson.

CONTENTS.

THURSDAY, APRIL 27, 1911.

A NEW CATALOGUE OF BRITISH BIRDS.

A List of British Birds, showing at a Glance the Exact Status of Each Species. Revised to August, 1910. By W. R. Ogilvie-Grant. Pp. 60. (London: Witherby and Co., 1909.) Price 1*s*. 6*d*.

THE old *order* changeth giving place to new, is true with a vengeance concerning lists of British birds, but there really does not seem to be any good reason for the changes. As all linear arrangements of birds must be unsatisfactory, why should we be annoyed with new anomalies of this kind, and constant changes in the arrangement and order of sequence of our birds in what ought to be works of reference? As if it really made any difference which comes first and comes last in the book! What the reader and student really does want to know is, whether he is to open the new book at the beginning or at the end to find, say, a crow or a duck, as the case may be. Unfortunately this is just what he cannot now know. We had become used to the change from the old arrangement which placed the birds of prey at the head, and had accepted that which began with the highly organised song-birds, but were not allowed to rest there. In the latest list now before us we begin with the game-birds (with which Seebohm ended), and end with the crows (which Sharpe put first)! And so on, and so on through all the miserable, useless changes.

The new list is printed in such a form that it can be cut up and used for labelling collections. The system adopted to indicate the status of each species is to assign each, by the use of numbered columns, to one of these five groups:—(1) Resident, breeds; (2) regular summer visitor, breeds; (3) regular autumn, winter, or spring visitor, does not breed; (4) occasional visitor, used to breed; (5) occasional visitor, never known to breed. When species have not occurred more than six times references are given to the works in which they have been recorded. But these are not, except in a few cases, to the original records. Occasional explanatory or amplifying notes are given, rendered desirable perhaps from the difficulties of grouping the birds which soon arise. For instance, the black-necked grebe seems out of place in the third column, for it is known to have bred here for years, and its breeding is mentioned in a note. The difficulties of grouping birds in this way are evidently great, and a system can hardly be considered satisfactory which leaves the avocet and great bustard (both now occasional visitors, which used to breed) in different columns, because apparently the great bustard is the rarer of the two as a visitor nowadays, and was *formerly* a resident, while the avocet was a summer visitor. Here again a note is necessary to qualify the latter's exclusion from the column "used to breed." Saunders's simple and masterly plan of indicating the status of a species by the type or fount, in his well-known list, if it did not indicate so much as the new catalogue (which the numerous additions to the British avifauna since 1907 have rendered necessary), at least had the merit of indicating that little very clearly.

The nomenclature in the present list differs somewhat from that used in the British Museum catalogues and guides, especially in the matter of such genera as Totanus and Tringa, which the author thinks (and we agree with him) have been split up for no very apparent reason. The author is clearly not a "splitter," as is evidenced by his leaving the black-headed bunting in the genus Emberiza. Mr. Grant does not use trinomials, and his acceptance of forms and races seems a little arbitrary. We may be thankful that he does not accept the British goldcrest, hedge-sparrow, tree creeper, &c., &c., although he does accept the British robin, another supposed local race, the existence of which as a subspecies is certainly not universally recognised. The square brackets, indicating species of which the history is doubtful, or which have, perhaps, been artificially introduced, seem to be somewhat arbitrarily applied; but this, it must be admitted, is largely a matter of individual opinion.

But to criticise the inclusion and exclusion of species, and the forms allowed and disallowed, would occupy too much space. Very largely, too, these are matters of opinion, and the opinions held are very diverse—the doctors differ. Yet some allusion must be made to the present attempt to indicate the modern status of our birds, insomuch as the difficulties encountered in the attempt, and already alluded to, become more apparent as we read through the list—difficulties which do not seem to be always satisfactorily surmounted. To take the honey buzzard, for instance. It is here stated to be a regular autumn, winter, or spring visitor, which does not breed, and there is a note appended that it formerly bred in Great Britain. The statement that it does not breed is a bold one, for nobody would be surprised at the discovery of a honey buzzard's nest in England any year. Its former status was undoubtedly that of a breeding summer visitor. It has become very rare, as such, of late years, and there is no recent record of its nesting. But there is no reason why birds should not arrive any year, and, if they escaped being shot by gamekeepers, breed. As in the case of other summer migrants, individuals from more northern countries pass here in autumn.

This bird and the golden oriole and hoopoe show the difficulties of this kind of concise classification. The original status of all three was "Summer visitor; breeding." But on account of their rarity, in different degrees, and the use of the word "regular" in column No. 2, a difficulty has been made of putting them all therein. Yet the hoopoe is put there with a qualifying note in almost the same words and to the same effect as that appended to the golden oriole (placed in column 4), and the honey buzzard is relegated to column 3, although the last-named bred more regularly in this country than either of the others, and while none of them breed regularly now it is not very improbable that any one of them might do so any year. The marsh harrier is included in column 3 among those birds which do "not breed," with a note appended saying that it "occasionally breeds." This really

K

amounts to saying that it retains its original status in the country, viz., resident. And this we should say is its real status—if status it has—although its numerical strength has gone down almost to vanishing point, and, as in the case of many other birds, wanderers from other parts occasionally occur. The fact is that it is almost impossible to indicate adequately the varied and often complex status of some of our birds by the present method without using such a number of columns as would make the method very cumbersome.

The "bridled guillemot" is included by name but not numbered as a species. Whatever this bird really is, its status is similar to that of the common guillemot. The greenshank, entered here as a summer visitor simply, is a winter visitor to Ireland at all events, and a spring and autumn migrant to England. Some reference is wanting to the migration of the ringed plover and to the small dark migratory race, regarded by some as a good subspecies. The claim of the stone curlew to be a resident is remarkably small and applies to one locality only. A qualifying note in the case of the little bittern might well have expressed the strong suspicion entertained of its former and recent breeding, and of its claim to be a rare summer visitor. The willow tit is not a subspecies of *P. borealis* but of *P. atricapillus*, of which *P. borealis* is itself a form. The occurrence of the latter is doubtful in the extreme. The tawny pipit is put in column 4 indicating that it "used to breed," with a note that it had bred in Sussex. But there is only one record of its ever doing so, and the reference given is to a local publication not generally available. Yet the wood sandpiper is relegated to the society of those that do not breed, and there is no mention of its undoubted former breeding in Northumberland. The shorelark is probably as regular a visitor as the Lapland bunting, yet they occupy places in 5 and 3 respectively. If the little owl (a weak candidate for the position of casual visitor until its introduction in large numbers) is to be called a "resident," there seems no reason for withholding the position from other introduced species which breed freely with us, and, given adequate protection, might maintain a wild existence in this country. The introduction is duly noted.

With regard to common names, great confusion might well arise from the quite unnecessary bestowal of the name "eared," as an alternate name, upon the Sclavonian grebe, for until recent years what is now generally called the black-necked grebe bore that name almost always. The pass to which the continual alteration of the Latin names of birds has brought us (by the raking up of ancient, doubtful, and little-known names under the plea of the law of priority) is well set before us in the present list by the fact that in order to show us exactly what bird is intended as the black-eared wheatear no fewer than five specific names (with their authorities) have been used for it and set down as synonyms; the one selected as the bird's right name (at the present moment!) being one which was long borne by another species! Thus is confusion worse confounded.

A new list of British birds was wanted, and the present one is clearly printed and well got-up. As it is printed on one side of the paper only, there is plenty of room for additions and any alterations the owner of a copy may like to make.

THE CONSERVATION OF SOIL WEALTH.

Soil Fertility and Permanent Agriculture. By Prof. C. G. Hopkins. Pp. xxiii+653. (London and Boston: Ginn and Co., n.d.) Price 10s. 6d.

PROF. CYRIL HOPKINS, of the Illinois Agricultural Station, is well known in the United States as the initiator of a systematic policy for restoring the fertility of the land of the east and middle west, which is in many respects a supplement to the great work of conserving the national resources that the late President succeeded in bringing home to the American public.

The problem is one quite distinct from the agricultural questions prevailing in western Europe. Up to the present time almost, it might be said that American agriculture has been extensive in its charter and wasteful in its methods. It has depended entirely upon the natural resources of the soil, and in many districts has only succeeded in exhausting them. In Virginia, in New England, and in many of the older States one may see great areas of indifferent farming and even of derelict land; land which has been cropped without due regard to the future until it has ceased to be profitable with the style of farming there in vogue and is now occupied only by comparatively backward cultivators, who draw but the poorest living from the soil. Even of the rich prairie lands of the middle west, in Illinois, Iowa, and Ohio, notwithstanding the enormous stock of plant food present in the soil when it was first taken into cultivation, a similar story is told. The yields on much of the land are declining, and the tendency on the part of the enterprising men to move west to the virgin soil has been very prominent of late in the migration of American farmers into those parts of western Canada that have lately been opened out.

With certain conspicuous exceptions the American farmer has always been raising a succession of crops which drew upon the resources of the soil; wheat has been alternated with corn and Timothy hay, and each crop has been either sold away from the farm or consumed in the great barns in which the stock are housed through the severe winters. In many cases the shortage of labour has prevented men from even restoring to the land the manure made by the stock, while no root crops are grown and no sheep are kept to run over the land and restore to the soil the fertilising ingredients that have been drawn from it by the fodder crops. And though the fertiliser trade in the United States is of enormous dimensions, it is too much confined to a relatively small class of intensive farmers, and does not represent a very large outlay on the total area of land under cultivation. Thus in many respects the condition of farming has been similar to that prevailing in Europe before the introduction of artificial fertilisers, that is to say,

that the farmer has been dependent upon the resources of the soil alone. In Europe, however, the cultivator has been forced by the lack of further land to a system of conservative farming which would maintain the fertility of the soil and the production of crops, at a somewhat low level, perhaps, but one that would show no decline for a very long period of time.

In the Norfolk four-course rotation, for example, all that is sold away from the farm is meat and corn; the straw, the hay, and the roots are more or less completely returned to the soil. The growth of the clover crop once in the rotation was more than capable of replacing the nitrogen sold away and the inevitable wastage. The stock of potash in the soil is so enormous as to be practically inexhaustible, and cultivation will slowly make it available. Only the phosphoric acid suffers a steady and irreplaceable loss under such a conservative system of farming, but this loss is not a very large one. Prof. Hopkins has made it his mission to awaken the Illinois farmer and his neighbours east of the Mississippi to a sense of the inevitable decline of the fertility of their land unless they also work out a similar conservative rotation, and he has shown them how this can most profitably be effected with the fertilising resources now available.

In his system Prof. Hopkins lays less stress upon the nitrogen question than we are accustomed to do in Europe. Even to-day the old prairie lands are still rich in nitrogen, and he considers that the introduction of a vigorous clover or cow-pea crop into the rotation will be sufficient to maintain the nitrogen at a profitable level for production. To secure a good clover crop it is necessary that there should be an ample supply of phosphoric acid and potash. Of the latter element the initial stock is large enough to last for many generations; all that is necessary is to bring it steadily into solution. To this end, and also to ensure the proper bacterial actions which both collect nitrogen and bring the organic nitrogen compounds in the soil into forms assimilable by plants, a neutral reaction is required in the soil, and Prof. Hopkins uses finely ground limestone in preference to the quick-lime which we more commonly employ. Then he turns to the phosphoric acid to complete the chain, and supplies this fundamental element by one of the mineral phosphates so abundant in Carolina or Florida in a finely ground condition, preferring the neutral finely ground rock to the artificially prepared acid superphosphates more common in Europe.

To Prof. Hopkins the ground phosphate is the keystone of the arch. The carbonate of lime is necessary to prepare the ground and to liberate the potash, but the phosphoric acid provides the item that was necessary for fertility, not only to the grain crops themselves, but to the nodule bacteria on the clover, which have to maintain the stock of nitrogen. Prof. Hopkins has demonstrated the success of his system experimentally at Urbana, and on many a farm in Illinois, and has taken up the propaganda of this method of restoring the waning fertility of the older lands of the United States with the zeal and conviction of a missionary. In this cause he has been brought into sharp conflict with the opinions that have issued from the Division of Soils at Washington, where Whitney and Cameron have put out their theory, which in its crude form as summarised for popular consumption, would seem to say that all soils are inexhaustible and equally rich as regards their mineral constituents, and that nothing is more required for fertility than a proper rotation and due attention to the conservation of the water supply, expenditure upon fertilisers being in the main unnecessary.

On the value of this theory and its application to practice this is not the place to enter, but the book before us is to a large extent a detailed statement of Prof. Hopkins's position and the justification of his belief in fertilisers, more particularly in ground limestone and rock phosphate, as a means of raising the level of productiveness in the United States.

Prof. Hopkins's book is designed on rather different lines from the usual treatise on agricultural chemistry, or even upon soils. After a general introduction on the elements of plant nutrition, he discusses in some detail the types of soils to be met with in the United States, and then goes on to develop his system of agriculture with an account of the materials necessary to maintain fertility. Here the reader will find a number of experimental data concerning the value of ground limestone in comparison with lime, and particularly of ground rock phosphate as against superphosphates and other manufactured fertilisers.

After a chapter of polemics on the theory of soil fertility, Prof. Hopkins proceeds to discuss field experiments, taking the Rothamsted experiments as a type of what may be expected under European conditions, and then summarising in a very convenient and interesting form for the European reader the work that has been done in Pennsylvania, Ohio, Illinois, Minnesota, and other American States. Though the book is written for the educated farmer, on this side of the Atlantic it is rather to the teacher and student that it will appeal, because our farmers will be strange to the conditions which render its main argument of so much importance. To the teacher, however, it is a mine of information; as it is also written with such vigour and refreshing conviction of the fundamental importance of its doctrine, we can well understand how Prof. Hopkins has become one of the really inspiriting forces in American agriculture.

A. D. H.

THE TERMITES OF CEYLON.

Termitenleben auf Ceylon, neue Studien zur Soziologie der Tiere zugleich ein Kapitel Kolonialer Forstentomologie. By Prof K. Escherich. Pp. xxxii + 263.2 pls. and 68 figures in the text. Jena: Gustav Fischer, 1911.) Price 6.50 marks.

THE termites (or white ants, as they are frequently though improperly called), although they belong to the order Neuroptera, exceedingly resemble the true ants in their habits, and are of almost equal interest. They are, however, tropical insects, and extremely destructive, and although one species has

established itself as far north as Bordeaux, it is fortunate that no species has yet been able to do so in the British Isles.

Prof. Escherich first devoted his attention to the termites during a tour in northern Abyssinia (Erythrea) four years ago, and, wishing to continue his studies on the same subject, selected Ceylon as most suitable for his purpose. Incidentally he estimates the number of species of termites already described as about 500, whereas about 5,000 species of ants are known. It is probable, however, that the difference is not solely due to termites having been less studied than ants, but to the number of species of the former being really much less numerous. The number of termites now known from Ceylon is thirty-five, of which four are possibly forms of others, leaving thirty-one undoubted species, nearly all collected by Prof. Escherich himself. The species of ants collected by Prof. Escherich in Ceylon number about seventy. He must have worked hard during his short stay in the island (from January 22 to the end of the first week in April), of which he gives an interesting account.

The first chapter of the main work is devoted to the nests of the mound-making termites, which vary much in form and size, and usually contain large fungus-beds. The larger termite-hills in Ceylon rise to a height of from 2 to 2½ metres, and the subterranean part is said by the natives to extend to a depth of ½ to 1 metre. The inhabitants of the nests are also described, and compared with the African *Termes bellicosus*. The latter species, however, is far more formidable, for the mandibles of the soldiers draw blood at every snap, while those of the Ceylon species can hardly pierce the skin of the hands, though they cling on firmly, and discharge an irritating liquid. Prof. Escherich disputes the usual notion that light is intolerable to termites; but it seems to us probable that this sensitiveness varies in different species. The huge size to which the abdomen of the queen termite attains is well known, but still more remarkable in the opposite direction is the figure of a soldier on p. 54, the head of which is nearly as large as the body, and the head and mandibles together much longer.

Several species of termites often inhabit one nest, and different species of ants are often associated with them in the same nests, as well as many other insects, &c. One peculiarity of the termite hills is the so-called "chimneys," open above, and running down into the nest, and efficiently providing for ventilation.

The second chapter of the book deals with the genus Eutermes, the species of which make their nests in wood, and are exceedingly destructive, while others construct long galleries, through which they march from one place to another. A third chapter is devoted to miscellaneous observations on queens, soldiers, behaviour towards light, &c., and a fourth to the economic importance of termites. Prof. Escherich considers that they are much less destructive in Ceylon than in Africa, and he discusses the best means of preventing their ravages, or of destroying them.

The book concludes with a series of valuable appendices by various authors, including descriptions of a considerable number of new species collected by Prof. Escherich, comprising termites, ants, and various Coleoptera, Orthoptera, Thysanura, Myriapoda, and Nemotoda, inhabiting the nests of termites in Ceylon.

ORIENTATION IN ORGANIC CHEMISTRY.

Über die Bestimmung des chemischen Ortes bei den aromatischen Substanzen. By W. Koerner. Pp. 132. (Leipzig: W. Engelmann, 1910.) Price 2.40 marks.

WILHELM KOERNER had the good fortune to become a student of Kekulé, in 1865, at a time when the latter was developing his benzene theory. After a year spent in Otling's laboratory, Koerner returned to Ghent as private assistant to Kekulé, and remained for a year in that capacity. He rapidly imbibed the views of his teacher, and, realising something of their far-reaching consequences, set before himself the task of experimentally demonstrating the truth of Kekulé's theory, a task which he never afterwards relinquished. The object of his first paper, published in 1866 in the *Comptes rendus*, was to link together the three series of di-derivatives of benzene. Thus, by preparing the three iodophenols and converting them by fusion with potash into the corresponding hydroxybenzenes, he was able to connect quinol with iodoaniline, iodophenol with catechol, and nitraniline with resorcinol, incorrectly regarded as the ortho, meta, and para series respectively. At the same time he criticised the speculative methods adopted by Baeyer, Graebe, and others as a basis for orientation.

In his second paper, published in 1867, he foreshadows his future method by pointing out that the trihydroxybenzene derived from the three dihydroxy-compounds must have the hydroxyls in the 1, 2, 4 position. His third paper contains a clear exposition of Kekulé's views on the constitution of the aromatic series with which we are so familiar. It is dated 1869 from the laboratory of Cannizzaro at Palermo, whither he had gone in 1867 to re-establish his health. When, later, he became lecturer on organic chemistry at the new technical college in Milan, he continued actively engaged in experimental work connected with his method of orientation, which he embodied in his fourth paper, published in 1874 in the "Gazzetta chimica italiana." It is in this last paper that Koerner collected the enormous mass of material which had been steadily accumulating since 1867.

The work, establishing for the first time by direct experimental evidence the true orientation of the simpler benzene derivatives, has taken its place as one of the classics of chemical literature, and chemists will welcome this last addition to *Ostwald's Klassiker*. The papers have been translated from French and Italian by Messrs. Bruni and Vanzetti, who have added a few explanatory notes. They have overlooked a curious transposition of the ninth line from the bottom of p. 4, which should be read as the bottom line.

J. B. C.

A PHILOSOPHICAL EVOLUTIONIST.

Der Wert der Menschheit in seiner historisch-philosophischen und seiner heutigen naturwissenschaftlichen Bedeutung. By Dr. F. Strecker. Pp. xiii+392. (Leipzig: W. Engelmann, 1910.) Price 7.40 marks.

THE author expounds a new interpretation of nature—a "Pythagorean-atomistic" evolution principle—which correlates a recognition of necessitarian uniformity with the concept of a high degree of contingency in natural happenings. The first part of the book is devoted to a historical sketch of the development of philosophic thought, in which the author discerns an analogy to the phyletic evolution of organisms. He then passes to a survey of the world of energies, and the discovery of its principle of development. The third section is devoted to the position of living organisms in nature, and here the author recognises that there is truth both in the vitalistic and in the mechanistic interpretations. But the mechanistic interpretations of vital activity that work are not like those which apply to the inorganic; there is a dualism and antagonism separating the two sets of formulæ. In fact, the organism stands by itself "with an independent genesis and tendency." In the fourth part of his book Dr. Strecker investigates the factors in the self-evolution of the animate world, and subjects "Darwinism" to a detailed criticism, his sympathies being Lamarckian. The chief point in the criticism is not unfamiliar, that selection is a secondary and directive, not a primary and originative factor. In the concluding part of this section there is an interesting discussion of "purposiveness," for instance, in development. This is regarded not as a fundamental property which explains things, but as a secondary achievement which has to be explained. It is not primary, but an outcome of progressive evolution. The concluding part of the book is on man's place in nature, and contains a vindication of an "anthropocentric" cosmology.

It may be of interest to give some further indication of the author's indictment of Darwinism. He criticises the concepts of the struggle for existence and natural selection, and shows that they tend to distract the attention from the primary fact and problem of the active organism, asserting itself in relation to the environment, and expressing itself ever in fresh form. In the second place, he seeks to show that some of the postulates are inconsistent with the actual facts of the case, and he raises difficulties, some of which have been very often discussed, regarding over-multiplication, the selection-value of a few additional millimetres on a primitive proboscidean's trunk, and the struggle among members of the same species. He utilises the facts of mutual aid as arguments against Darwinism, and in so doing shows, as it seems to us, a Procrustean conception of what the struggle for existence means.

Dr. Strecker leads his readers in an interesting way from the errors of Darwinism to the truth that is in Lamarck, and we are left at least with the impression that some compromise must be arrived at between the two interpretations. Not the least striking part of the book is the thesis that Darwinism is wrapped up with mechanistic, and Lamarckism with vitalistic views, and from this the author goes on to show that a recognition of the partial truth on either hand is to be found in his own particular theory of the "anthropocentric position" of man in the universe.

J. A. T.

RECENT PROGRESS OF SCIENCE.

Fortschritte der naturwissenschaftlichen Forschung. Edited by Prof. E. Abderhalden. Vol. i., pp. viii+306. Vol. ii., pp. iv+364. (Berlin and Vienna: Urban und Schwarzenberg, 1910–11.) Price, vol i., 10 marks; vol. ii., 12 marks.

THE plan of this new publication is to furnish summaries of recent results in selected departments of knowledge in which some degree of settlement and certainty has already been reached. This policy will avoid any risk of wasting time on raw speculations, and, under the able guidance of a man of Dr. Abderhalden's experience and prodigious industry, the series promises to be useful and judiciously chosen. In these first two volumes the subjects dealt with are colour photography (Miethe), fire-damp-resisting explosives (Brunswig), slow combustion and oxidation ferments (Bach), methods and recent results of gravitation measurements (Niethammer), development of picture telegraphy (Korn), recent methods of solar investigation (Guthnick), fermentation in living and "killed" plants (Palladin), origin of petroleum (Engler). Vol. ii.:—Inheritance of acquired characters (Semon), fossil lung-breathing aquatic animals (Stromer), volcanic research (Sapper), ions and electrons (Mie), utilisation of atmospheric nitrogen (Frenzel), cretinic degeneration, goitre, and deaf-mutism (Bircher), and muscular atrophy (Bing).

All these essays, written by men who have done some original work on the subjects dealt with (and sometimes a great deal of work), are well written, and occasionally only disappointing to the uninitiated on account of their caution. Thus Miethe regards a further sensational development of colour photography as very unlikely; Korn throws cold water on the problem of vision at a distance; and Sapper, after an exhaustive parade of recent volcanic theories (including Strutt's radio-activity speculations), calls for more facts. Some of the contributors are more positive. Brunswig confidently expects the discovery of a satisfactory explosive for coal-mines by judicious admixture of non-explosive material; Palladin considers the loss of coordination in the production of ferments after killing (by cold or narcotics) as definitely established; Semon commits himself to a modified Lamarckism on a basis of "mnemes" and "engrams"; and Bircher regards the influence of soil and water on cretinism as proven. Engler favours the view which ascribes the origin of petroleum to fossil animal fats.

The remaining articles are more or less neutral, but no less admirable, summaries of recent work. Mie's "Ions and Electrons" emphasises Maxwell's views of the æther rather more than we are accustomed to

find in Germany nowadays. It shows that the school which would regard the æther as a mere "physical space" has not yet captured all the Continental seats of learning. The further volumes are to appear at the rate of two per annum, and the list of forthcoming essays is distinctly attractive.

DISJUNCTIVE GEOGRAPHY.

A Systematic Geography of America. By G. W. Webb. Pp. viii+108. (London: Methuen and Co., Ltd., n.d.) Price 1s.

"THIS book—the fourth of a series of five—deals with the geography of the New World. As in the previous volumes, the treatment of the subject is on logical and modern lines, and the book will be found to contain the kind of information that candidates preparing for fairly advanced examinations in geography are now expected to acquire." Instances of the absence of modernity in the treatment are striking; for example, the rain of California is attributed to the north-east trades, without mention of its characteristic winter maximum, and in disregard of Buchan's maps on wind directions.

The space devoted to Argentina is the same as that given to Peru, and but one-quarter of that given to Canada. In view of the information which is accessible in the "Statesman's Year Book," the "Atlas of the World's Commerce," and the publications of the United States Government, the treatment of minerals in Mexico, the reference to cotton ports and to the trade of the United States ports on the Pacific, as well as the arbitrary division between the "wheat" and "maize" belts by lat. 42° N. are curious, and, on the whole, misleading. Mexico is first as to the production of silver, and produces copper, but not iron and tin to any extent.

Much is made of "Sea-island" cotton, but the total production of that variety is, roughly, 1/200th of the United States cotton crop, and stress is laid upon Mobile, Wilmington, Charleston, and Pensacola as cotton ports when really about three-quarters of the cotton exports go from Galveston, New Orleans, Savannah, and New York. On the Pacific coast Portland is suggested as of more importance than the ports on Puget Sound, when its trade is roughly only about one-third of that of the more northern ports. There seems hardly any excuse for the limitation of the "wheat" belt by latitude, especially as Wisconsin is named in large type, and the fact that in relation to area of land in the respective territories Pennsylvania is more important than Michigan is ignored.

On the whole the book contains many isolated facts, but surely modern ideas in geography demand a statement of facts in relation to each other; *e.g.* climate is discussed in an introductory chapter, and on the "wheat" belt the author writes:—"The winters in this region are very cold; the summers are warm, but not warm enough to ripen maize"; yet S. Dakota, Minnesota, Wisconsin, and Michigan produce annually over 200 million bushels of maize on the average. It appears that the defects are due to indiscriminate use of statements made in other text-books.

B. C. W.

OUR BOOK SHELF.

Laboratory Notes on Organic Chemistry for Medical Students. By Dr. Paul Haas. Pp. viii+128. (London: Macmillan and Co., Ltd., 1910.) Price 2s. 6d. net.

IT is generally recognised that a knowledge of organic chemistry is becoming more and more essential for the proper study of physiology and the medical sciences, but, on the other hand, the complaint is frequently heard that the curriculum of the medical student is becoming seriously overcrowded, and that science work is encroaching too far on the more professional studies.

The new syllabus of the second medical examination, part i., of the London University is the result of a compromise between these two points of view, and an attempt is being made to teach organic chemistry with special reference to its applications in physiology, pharmacology, and pathology, and while giving a sound elementary knowledge of the principles of the subject to illustrate them as far as possible by means of substances of importance in the aminol economy.

The book under review covers the practical syllabus of the above examination, and we may say at once that it is a good book, though it suffers from the defects inherent in any work written for so special a purpose. The first half of the book contains a lucid and thoughtful account of the general methods of organic chemistry, illustrative methods of preparation, and the various quantitative exercises mentioned in the syllabus. The second half is devoted to qualitative tests for a number of substances of physiological importance; and the practical recipes for preparing these substances, many of which are expensive and difficult to obtain in the market, will be found exceedingly useful, particularly by those teachers who may not be specially familiar with biochemical methods. A sufficient account of the theoretical principle underlying the various exercises and tests is given, and, where possible, the bearing of the subject on the future work of the student is emphasised, so that he may realise that chemistry is not to be regarded merely as an examination subject, but rather as a valuable adjunct to his knowledge for the fuller appreciation of his clinical and other studies. The book will, we think, be useful both to students and teachers.

Die Kalte: ihr Wesen, ihre Erzeugung und Verwertung. By Dr. H. Alt. Pp. v+124. (Leipzig: B. G. Teubner, 1910.) Price 1.25 marks.

THIS little book is based upon a series of six lectures delivered in München during 1907 by the author. Dr. Alt has endeavoured to popularise the subjects of the production of cold and the physics of low temperatures so as to render them both interesting and useful to the beginner. No special knowledge of this particular branch of physics is assumed; a general intelligence and interest in natural phenomena is all that is expected of the reader. With this in view the author devotes the first two chapters to matter which finds a place in almost any elementary treatise on heat. In the first chapter the properties and laws of gases are discussed, and in the second, those of vapours, both being obviously necessary preliminaries to the appreciation of the remaining sections of the book.

The production of cold by means of the reversed heat-engine, together with descriptions of the various types of refrigerator, form the subject of the next chapter; the remaining three are concerned with the question of the liquefaction of gases. The different processes by which liquefaction has been secured are described in chronological order, starting with the earlier regenerative process and leading up to the

methods by which hydrogen and helium have been liquefied by means of various improvements. Attention is directed in the concluding chapter to the many uses, both in the laboratory and commercially, to which low temperatures may be applied, such as the separation of the various ingredients of air by fractional distillation.

Most of the important points in connection with the production and applications of cold are to be found, treated in an elementary and lucid manner, in this book, which should serve admirably the purpose intended by its author.

Was die meisten Amateur- und manche Fachphotographen nicht wissen: Ein Handbuch praktischer Ratschläge und Erfahrungen. By Prof. F. Schmidt. Pp. xiii+175. (Leipzig: Verlag Otto Nemnich, 1911.)

The author finds that amateurs and even expert photographers often fail to take the trouble to understand their work, and are ignorant, not only of the principles upon which it is founded, and which are therefore the only safe guides to its successful application, but also of many simple practical and commercial facts concerning it. So he has prepared this volume in sections varying in length from a line or two to a page or two, each with a conspicuously printed heading indicating the subject treated. The arrangement is exactly the old style of question and answer, except that the question is put in the form of a statement or title, such as "What a landscape lens is," "When one mav dilute the developer," and so on. The information is generally of the kind that would be called elementary, tending in parts perhaps to be too superficial, and may be accepted as evidence that even in Germany, where education is so well systematised, the general knowledge concerning so common an applied science as photography is behind the needs of the times. Many convenient and some apparently novel methods are given, as, for example, to facilitate necessary calculations. A drawback to the book from the point of view of the English reader is that in the lists of makers of different kinds of lenses, sensitive materials, &c., although there are included some little-known German firms, English firms appear to be ignored altogether.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by Dr. A. E. Shipley, F.R.S., assisted by G. A. K. Marshall. Rhynchota. Vol. v., Heteroptera. Appendix by W. L. Distant. Pp. xii+362. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co.; Berlin: R. Friedländer and Son, 1910.) Price 10s.

In this supplementary volume, Mr. Distant describes a large number of species which have recently come into his hands, but most of which have already been described in advance of the present work in the *Annals and Magazine of Natural History*, the *Annales de la Soc. Ent. de Belgique*, &c.; and thus he completes his work on the Indian Heteroptera. This volume extends from the family Lygæidæ to the family Corixidæ, and we are informed that "A further volume, which will form an appendix to the Homoptera, will complete the enumeration of the Indian Rhynchota, with the exception of the families Psyllidæ, Aphididæ, Aleurodidæ, and Coccidæ." The species here described extend from Nos. 2769 to 3135, and are illustrated by 214 excellent illustrations in the text. The first page is devoted to controversial questions of nomenclature, and a few bibliographical notes.

Nigeria and its Tin Fields. By A. F. Calvert. Pp. xvi+188+259 plates. (London: Edward Stanford, 1910.) Price 3s. 6d.

This book is intended to provide information concerning Nigeria, to which special attention has recently been directed by the revelation of vast alluvial tin deposits in the province of Bauchi (northern Nigeria). The author discusses the present means of communication, the possibility of railway development, and the character of tin deposits, which are situated about 3000 to 4000 feet above sea-level. He states that it is estimated that the tin deposits are scattered over an area of about 2500 square miles, that the tin produced is considered to be some of the best ever imported into Europe, and that it commands a price equal to, if not higher than, that of the Straits tin. Details are given of the companies which are at work, and the new mining regulations are stated in full. One interesting feature of the book is the large number of illustrations, which are collected together at the end.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–10. Edited by E. J. Brooksmith and R. M. Milne. Various papers, separately paged. (London: Macmillan and Co., Ltd., 1911.) Price 6s.

The editors have provided answers to the questions set during the past six years for candidates seeking admission to the Royal Military Academy and College. Teachers whose duty it is to prepare candidates for these examinations should find the publication a convenience.

Huxley and Education. By Prof. H. F. Osborn. Pp. 45. (New York: Charles Scribner's Sons, 1910.)

Prof. Osborn's address at the opening of the college year at Columbia University last September is here printed in the form of a book for the pocket. Some of his remarks remind one of the aphorisms of his old master, Huxley. To quote one example:—"Do not climb that mountain of learning in the hope that when you reach the summit you will be able to think for yourself; think for yourself while you are climbing."

William Ford Stanley. His Life and Work. Edited by Richard Inwards. Pp. 82. (London: Crosby Lockwood and Son, 1911.) Price 2s. 6d. net.

The first five chapters of this book are autobiographical, and in the remaining four the editor gives an interesting account of the late Mr. Stanley's active life. There are two appendices, the first being an article on technical trade schools, which was the last paper written by Mr. Stanley, and the second the events in Mr. Stanley's life arranged in chronological order. The book will be interesting to many readers.

Die Elemente der Entwicklungslehre des Menschen und der Wirbeltiere. By Prof. O. Hertwig. Vierte Auflage. Pp. viii+458. (Jena: Gustav Fischer.) Price 9.50 marks.

The first edition of this work on the leading facts of embryological science was noticed in Nature of April 26, 1900 (p. 610). The work has been enlarged by about fifty pages, and there are now 399 figures instead of the 332 in the original edition. For students familiar with the German language, the volume provides an excellent introduction to embryology.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Daylight Saving?

MAY I make a few observations with regard to Prof. Milne's article in NATURE of April 6 on Daylight Saving? Leaving aside the inquiry as to whether the clerks of Cornwall are happier than those of Kent, to which I am not able to give an answer (though it is possible that, as these counties differ in other respects than that considered, a mere yes or no might have little value as evidence), one may direct attention to the next argument as to workers who have to commence their work at 6 in the morning. The graphic account which Prof. Milne gives as to the hardships which these workers would have to suffer under the proposed scheme, would be heart-rending, had he not thoughtfully supplied the remedy in his last paragraph. Why should they not start work an hour later in summer? later, that is, according to the new setting of the clocks? This is a "simple solution" on Prof. Milne's own showing.

In my practical engineering days I found that one of my greatest privations was due to the fact that my evenings had to terminate (in order that I might rise early in the mornings) earlier than those of my friends, and evening engagements were generally inconveniently late. Now, under the proposed scheme all evening engagements, except such as are organised by these workers for their own convenience, would take place an hour earlier (absolute time), and consequently the effect of the change would be probably, if anything, an advantage to the 6 o'clock workers, provided they accepted the simple solution suggested. In fact, their day *is now* disjointed from that of the rest of the world, and under the new scheme this defect would be at least partially remedied.

Prof. Milne's fifth paragraph seems to be inconsistent with his simple solution. I am surprised to hear the "half-asleep" argument seriously brought forward. If one rises and retires an hour earlier, but works, takes meals, &c., at the old times, the argument is valid, but not, I think, when work, &c., fall in automatically with the new times of rising and retiring. On a journey to Vancouver and back I altered my watch more than twenty times, but felt no inconvenience whatever, because all engagements altered in the same way.

As to defects, inconvenience to meteorologists, steamship companies, &c., we must, of course, try to weigh these as justly as possible against the advantages of the scheme, but I think that technical and academic points, and even practical questions like the adjustment of steamship and boat-train times, should not be allowed to weigh very heavily against any large amount of real advantage to the workers of the country which the scheme might be calculated to afford.

With regard to the last paragraph of the paper, one may remark that the solution suggested, that business people should begin work an hour earlier in summer, really leads us on inevitably to the daylight proposal itself. For if business (apart from factories, &c., with which I have already dealt, which form an obvious exception) begins and ends an hour earlier, then the general activities of the country must follow suit. It would be impracticable, for instance, for shops to open at 7 instead of 8 and close at 6 instead of 7 (say) at night, while the shopping public still ordered their doings according to the old times; and if all business and other people adopted the plan suggested, then all other pursuits engaged in by them must follow. Thus all engagements, trains, and what not must be altered.

Now, manifestly, by far the simplest mode of carrying out this change would be to alter the clocks, and then allow all the activities of life to go on to the same time schedule as before. Not only is this the simplest way, but I think it will be admitted that it is the *only way* which would have the slightest chance of being *actually realised* in practice.

In conclusion, I may say that my object in writing has not been to support the daylight saving proposal itself, but rather to direct attention to what seemed to me to be vulnerable points in the arguments (as arguments) under discussion.

L. SOUTHERNS.

IN my note on the so-called Daylight Saving proposal, I repeated a suggestion made by many, viz., that a simple solution to the whole question would be to commence work one hour earlier during the summer, and do this without confusing ourselves and others without altering the clocks. Why Mr. Southerns quotes me as saying *one hour later* I do not know. The main point, however, to which practically no reference is made is that the majority of workers in Great Britain will, if the time-saving scheme comes into force, have to rise at 4 a.m. instead of 5 a.m. for six months in the year. This is increasing darkness and not saving daylight. It is all very well to say that the total population in Great Britain will, if they go to bed one hour earlier, save two and a half million pounds on illumination, but it would only be fair if the promoters of this new-fangled idea would tell the inhabitants of Great Britain how many millions they would have to spend on extra illumination required in the morning. You cannot make a piece of cloth longer by cutting off one end and sewing it on the other.

Mr. Southerns says that he is "surprised" at hearing what he aptly terms the "half-asleep argument." To be surprised at an argument, however, is not the best way to refute it. Thus I may be surprised, even greatly astonished, at much that Mr. Southerns says in his letter, but I do not expect that the most dramatic exhibition of my personal feeling will carry conviction to his or anyone else's mind. I am therefore compelled to relate a few facts which have a direct bearing on this matter. Of these facts Mr. Southerns is evidently without knowledge, and it may be assumed that others who support this remarkable Bill are in a like state of darkness.

In the first place, as the result of innumerable experiments and observations by many distinguished investigators, it has been definitely ascertained that bodily and mental efficiency are not maintained at the same level throughout the day, and that the course of efficiency, if plotted diagrammatically, describes a curve with a morning maximum between ten and eleven; an afternoon maximum about five, and in late workers a third elevation, which has been termed "end-glow." With the afternoon and evening measures of efficiency I am not concerned; what I wish to emphasise here is that there is a gradual increase in bodily and mental efficiency from the hour of waking up to between ten and eleven in the great majority of workers of all kinds; *i.e.* that sleep imposes an inertness the influence of which passes away, only slowly on arising. There is, in fact, what Dr. Howard Marsh, in an interesting book on "The Diurnal Course of Efficiency," calls a "warming-up period."

Now for the important matter of habit. The results of experiments show that the immediate effect of breaking habits is apt to be detrimental to the output of work, whatever that habit may be. So firmly does habit impress itself upon the reaction of man to his environment, that Patrick and Gilbert, for instance, show that in subjects kept awake for seventy-two hours, and subjected to tests every six hours, the worst results were obtained invariably *at the periods ordinarily devoted to sleep*, thus showing the recurrent nature of an established habit, and how important is the influence of this upon the output of work, hence for some time after the shifting of time, should it be brought about, we should anticipate that the efficiency of workers would be impaired.

J. MILNE.

Seiches in Windermere.

WINDERMERE is peculiar as regards seiches, since it is nearly divided in two by islands and shallow water near the middle. On account of this the two halves of the lake oscillate independently, but an oscillation can be detected which is due to the uninodal seiche of the whole lake. Because of the shallow water near the middle, this has only a small amplitude and a very long period (69·7m.), and is soon damped out.

A recording apparatus was first set up near the upper

end of the lower half of the lake. The water, however, was shallow in this part of the lake, and the records are rather disturbed by local effects due to wind. The periods of the seiches detected here were 20·4 minutes, 11·9 minutes, and 3·3 minutes. The 20·4-minute and 11·9-minute periods are due to the uninodal and binodal seiches of the lower half of the lake. The 3·3-minute period is probably

Fig. 1.—Recording Limnograph.

due to a transverse seiche. The maximum range recorded was about an inch.

After this, the recording apparatus was set up at the head of the lake. The upper half of the lake being much deeper than the lower half, better records were obtained. The maximum range recorded was about 1½ inches. The periods here were well marked, and had the following times:—69·7 minutes, due to the uninodal seiche of the whole lake; 14·1 minutes and 6·6 minutes, due to the uninodal and binodal seiches, respectively, of the upper half of the lake; also a well-marked, short period of 3·4 minutes. This last period is probably due to the trinodal seiche, and also to a transverse seiche, which has nearly the same period. In some cases, the movement due to this oscillation alone was nearly an inch.

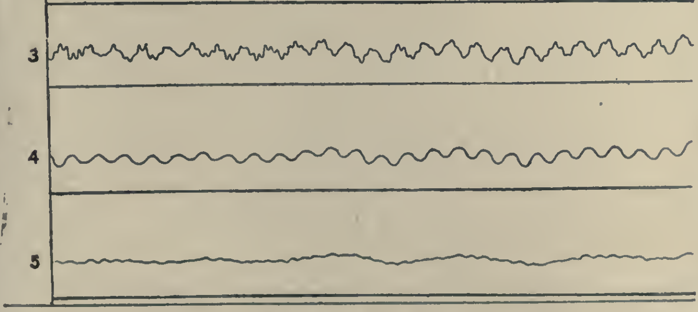


Fig. 2.—Traces obtained at Head of Windermere.

The figure shows some of the traces obtained. Nos. 1, 2, and 3 are typical traces obtained at the head of the lake. Nos. 4 and 5 are obtained from No. 3 by Prof. Chrystal's method of residuation. The 3·4-minute period is seen in the original trace. No. 4 shows the 14·1-minute and 69·7-minute periods, and is obtained by residuating out the 3·4-minute and 6·6-minute periods. No. 5 shows the 6·6-minute and the 69·7-minute periods, after the 3·4-minute and the 14·1-minute periods have been residuated out. In Nos. 1 and 2 the rate of movement of the paper was one inch in 18·8 minutes, and in No. 3 one inch in 23·2 minutes.

During the later experiments a form of apparatus was used which proved quite satisfactory, and, being simple to construct, may be worth briefly describing. A strip of paper, from a continuous roll fixed on the base of the instrument, passes up and over a horizontal wooden cylinder, 3 inches in diameter, and driven by clockwork. After passing half-way round the cylinder, the paper passes under a small roller carried on springs. This roller presses the paper against the wooden cylinder, and, since the paper passes half-way round the cylinder before passing under the roller, there is no possibility of it slipping.

A horizontal lever is pivoted to the base of the instrument, one end of which projects outwards, and is connected to the float by a string, while the other end carries a weight. The pen and holder are carried by a horizontal rod, which is supported by two upright arms, being fixed to them at each end by pivots. One of these arms is fixed to the lever, at the place where it is pivoted to the base of the instrument, while the other arm is pivoted direct to the base. As the float moves up and down, this horizontal rod moves backwards and forwards, parallel to the axis of the wooden cylinder. On the horizontal rod are bearings, which carry the light frame holding the pen, which rests on the top of the wooden cylinder. When the lever is half-way up or down, the bearings of the pen are about the same height as the top of the wooden cylinder, then, as the float moves the lever up and down, the pen moves in an almost straight line across the paper on the top of the cylinder.

This apparatus is simple to construct, and, since the only friction is in the pen and the four pivots, the whole system moves very freely, and a float 5 inches in diameter will work it easily, while Chrystal's "waggon" recorder requires a 10-inch float. Gordon Dobson.

Caius College, Cambridge, April 19.

The Flight of Exocœtus.

Practical difficulties will prevent the settlement of the question as to whether or no a flying fish supports itself by movement of its fins by the method suggested by a correspondent in Nature of February 9, viz. kinematograph photography.

Anatomy and phylogeny converge to the support of those observers who declare that the "wings" are motionless during "flight."

(1) Any resemblance to the huge musculature of birds is out of the question, but if the wings vibrate to any purpose, something resembling in scale the muscular and nervous specialisation found in insects should obtain here. Has anything of the sort been found? On the contrary, the muscular development of Exocœtus is, like that of other fish, directed to propulsion by the tail.

(2) The structure and habits of the lower members of the family, Hemiramphus and Belone, indicate stages in the evolution of Exocœtus. The former is able to make great leaps nearly parallel to the surface, of such force, indeed, that the natives here tell me of men who have been pierced by the elongated lower jaw two inches deep in the flesh of the leg when wading among them. "When it is out of the water it is quite mad and strikes whatever is in the way, whether a man or a boat, and so kills itself," to quote their description.

Belone can almost fly, its effort having the appearance of running on the surface on the tip of its tail, suggesting some use of this member, but not of the normal-sized fins, in extending the range of "flight." These two steps in the evolution of the habit of Exocœtus distinctly lead to the

idea of a parachute leap, but do not at all support an evolution of flight by beating wings.

Exocœtus is the natural parallel of the aëroplane, which, it is hoped, will rise from and descend upon water with ease and perfect safety. The flying fish, however, frequently strikes a wave with one fin and is overturned, or strikes it with violence. It would be very interesting to know whether Belone does aid itself by its tail, and so is in some way a parallel to the hydroplane boat.

CYRIL CROSSLAND.

Dongonab, Port Sudan, Red Sea, March 24.

The Stinging Tree of Formosa.

WITH reference to the letter on the Stinging Tree of Formosa in NATURE of March 2, it would be interesting if your correspondent would throw light on the exact mechanism by which the sting in *Laportea pterostigma* and *L. crenulata* is produced. *L. crenulata* is locally abundant in some parts of India. The curious point is that the leaves are often glabrous. Moreover, the stinging effects are, apparently, sometimes experienced without actual contact with the plant. I was one day walking through the hot, steaming forests near the Tista River, in British Sikhim, with a friend. The Laportea was abundant, and we carefully avoided it. On our way home my friend was seized with the peculiar stinging sensations of the Laportea in several parts of his body. These lasted several days, and on the night immediately after being stung became so bad that he was unable to get any rest and became feverish.

On another occasion I had to cut a survey line through dense forest with an undergrowth of *L. crenulata*. The coolies avoided the leaves as much as possible, and cut the stems low. Some of them were stung on the body, but all were attacked in different degrees with sneezing, violent catarrh, and ultimately vertigo. I myself, although at some distance from the actual cutting operations, though I had to walk up the cut line, suffered to a less degree in the same way. Yet I have often dashed a leaf across the back of my hand with no ill effects! Sir J. Hooker and others have noted that the effects are worse at some times of the year than at others. The inflorescence, it should be noted, is covered with hairs, and I have only been able to account for the facts above described by supposing that it is these deciduous hairs of the inflorescence which get into the clothes and become inhaled when the tree is shaken.

H. H. HAINES.

Camp, Central Provinces, India, March 24.

Fundamental Notions in Vector Analysis.

I SHALL be much obliged if you will kindly permit me, through the columns of NATURE, to make some suggestions regarding fundamental conceptions in vector analysis, a subject which was vigorously discussed in this journal about twenty years ago (NATURE, vols. xliii., xliv., xlvii., xlviii., xlix.). The discussion showed that the slow progress of vector analysis was in a large measure due to the want of unanimity as to its fundamental notions and notations, and to an unfortunate aspect peculiar to it, viz., a strong conviction on the part of the advocate of any one of the various systems of vector analysis, that the other systems, if allowed to grow, will do more harm than good, while it may be noticed that in our ordinary scalar analysis, although several systems (*e.g.* Cartesian, polar, pedal, trilinear, &c.) exist side by side, there is no such feeling. My object now is to suggest a system which, while it aims at a reconcilement between the various systems, will contain the best features of each of these known systems.

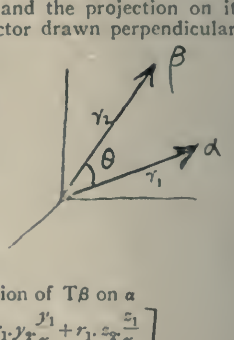
Dr. Knott (NATURE, vol. xlvii., p. 590) justifies the introduction of the quaternion as a fundamental conception by saying that it is only a generalisation to the case of vectors of the quotient (in the case of scalars) of two lengths. But a great objection is that the quaternion—a hybrid conception, in part a scalar and in part a vector—is not *by itself* capable of being defined in terms of the three fundamental entities, magnitude, direction, and position, as every *fundamental* conception ought to be. No such thing can, however, be said of the fundamental notions of the non-quaternionists, the scalar product and the vector product, which are defined in terms of only the fundamental notions of geometry and trigonometry. I may also repeat an argument of Prof. Gibbs (NATURE, vol. xlvii., p. 463) that the introduction of the scalar product and the vector product as fundamental conceptions will meet Prof. McAulay's observation (*Ph. Mg.*, vol. xxxiii. 1892, p. 477) that the arrest in the development of vector analysis is due to the circumstance that quaternions are "independent plants that require separate sowing and consequent careful tending." Besides, as is pointed out by Prof. Gibbs (NATURE, vol. xliii., p. 511), it is not desirable that the simpler conceptions should be expressed in terms of those which are by no means so. It is not sufficient to say, as has been argued (Heaviside, NATURE, vol. xlvii., p. 533), that vector analysis should have a purely vectorial basis; for that would only be a play of words.

Now, although the non-quaternionists thus avoid certain initial difficulties in presenting the subject, some of them, viz., Mr. Heaviside and Prof. Macfarlane, have made innovations which not only have no justification, but have created insuperable difficulties. We must have $\alpha^2=-1$, and we must recognise the versional character of the vector; the principles of vector algebra must differ as little as possible from the principles of scalar algebra, and we cannot be blind to the usual meaning of equations such as $ij=k$, &c., as was pointed out by Dr. Knott (NATURE, vol. xlviii., p. 148; vol. xlvii., p. 590). All these difficulties and others have arisen from an attempt to oust the conception of a quaternion, whether in the initial or at any later stage. So supreme is the contempt that Gibbs, while dealing with the theory of dyadics, regards $\alpha\beta+\lambda\mu+\gamma\nu$, a sum of expressions analogous to the quaternions, as indeterminate, merely symbolic, having physical meaning only when used as operator, although scalars and vectors are derived from it.

It is unfortunate that the advocates of vector analysis cannot work in harmony with one another, recognising superiority of each other in particular respects. Although Gibbs admits that the quaternionic method has advantages in certain cases, he would not tolerate its existence in the field of vector analysis, or rely upon it in places where he has found advantages.

With regard to the question of notations, I may refer to NATURE, vol. xlvii., p. 590, where Dr. Knott rightly says that the symbols used by the quaternionists for the scalar product and the vector product express at once and clearly the nature of the functions they represent, and that it is not proper to use the sign of ordinary multiplication in a case which does not admit of one of the factors being carried over to the other side as a divisor.

I shall now work out the successive stages of introducing the proposed system. We shall begin with the scalar product, $S\alpha\beta$, and the vector product, $V\alpha\beta$, defining the former as a quantity equal to minus the product of the length of one of the vectors, α, β, and the projection on it of the other, and the latter as a vector drawn perpendicular to the plane of the vectors, of a length equal to the area of the parallelogram determined by them, so that rotation round it from α to β through an angle less than 180° is positive. We see that we shall have



$$S\alpha\beta=S\beta\alpha,\quad V\alpha\beta=-V\beta\alpha.$$

Now if we take $\alpha=ix_1+jy_1+kz_1$

$$\beta=ix_2+jy_2+kz_2$$

we have,
$$\begin{aligned}S\alpha\beta &= -T\alpha T\beta\cos\theta\\ &= -T\alpha\times\text{ projection of }T\beta\text{ on }\alpha\\ &= -\left[r_1.x_2.\frac{x_1}{r_1}+r_1.y_2.\frac{y_1}{r_1}+r_1.z_2.\frac{z_1}{r_1}\right]\\ &= -(x_1x_2+y_1y_2+z_1z_2\end{aligned}$$

$$\begin{aligned}V\alpha\beta = {} & i\text{ (projection of area of parm. }\alpha,\beta\text{ on }x\text{ plane)}\\ & +j\text{ (projection of area of parm. }\alpha,\beta\text{ on }y\text{ plane)}\\ & +k\text{ (projection of area of parm. }\alpha,\beta\text{ on }z\text{ plane)}\\ = {} & (y_1i_1z_2-y_2z_1)+j(z_1x_2-z_2x_1)+k(x_1y_2-x_2v\end{aligned}$$

$$\begin{aligned}\therefore\ S\alpha\beta+V\alpha\beta &= -(x_1x_2+y_1y_2+z_1z_2)+i(y_1z_2-y_2z_1)+\\ &\quad j(z_1x_2-z_2x_1)+k(x_1y_2-x_2y_1)\\ &= (ix_1+jy_1+kz_1)(ix_2+jy_2+kz_2)\\ &= \alpha\beta.\end{aligned}$$

We thus arrive at an auxiliary, $\alpha\beta$, connected with the fundamental notions by the relation, $\alpha\beta = S\alpha\beta + V\alpha\beta$, an auxiliary the geometrical meaning of which will be seen below.

We then note the special case $\alpha^2 = S\alpha^2 = -(T\alpha)^2$ so that $\frac{1}{\alpha} = -\frac{\alpha}{T\alpha^2}$. With the help of this relation, we shall assign meanings to $S\frac{\beta}{\alpha}$, $V\frac{\beta}{\alpha}$:

$$S\frac{\beta}{\alpha} = S\frac{-\beta\alpha}{T\alpha^2} = \frac{-S\beta\alpha}{T\alpha^2}$$

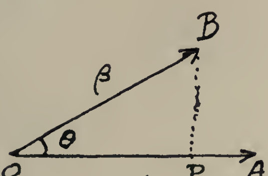
$$V\frac{\beta}{\alpha} = V\frac{-\beta\alpha}{T\alpha^2} = \frac{-V\beta\alpha}{T\alpha^2}$$

From these we have $S\frac{\beta}{\alpha} + V\frac{\beta}{\alpha} = -\frac{1}{T\alpha^2}(S\beta\alpha + V\beta\alpha)$

$$= \frac{-\beta\alpha}{T\alpha^2}$$

$$= \frac{\beta}{\alpha}$$

Apart from this, the following geometrical consideration will justify our introduction of the quotient and the conception of an operator :—



$$S\frac{\beta}{\alpha} + V\frac{\beta}{\alpha} = S\frac{-\beta\alpha}{T\alpha^2} + V\frac{-\beta\alpha}{T\alpha^2}$$

$$= \frac{T\beta . T\alpha \cos\theta}{T\alpha^2} + \epsilon . \frac{T\beta . T\alpha \sin\theta}{T\alpha^2}$$

where ϵ is an unit vector $+r$ to plane α, β

$$= \frac{T\beta \cos\theta}{T\alpha} + \epsilon . \frac{T\beta \sin\theta}{T\alpha}$$

$$= \frac{OP}{OA} + \frac{PB}{OA} = \frac{OB}{OA} = \frac{\beta}{\alpha}$$

We have *now*, but not earlier, the conception of our auxiliary, whether the product $\alpha\beta$ or the quotient $\frac{\beta}{\alpha}$, as an operator turning one vector into another, the former β^{-1} into α and the latter α into β; this would, as usual, justify our calling by their old name (quaternion) these auxiliaries which we have here *obtained from* our fundamental conceptions, the scalar product and the vector product. We may now proceed further and introduce into our system the conception of the axes and the angle of a quaternion. We may, and as a matter of fact shall, use the quaternion whenever we find it expedient, but we must not make it our fundamental notion.

In view of the diversity of opinion shown above, some modification and reconcilement on the lines suggested above or on some other lines are absolutely necessary, if the advocates of vector analysis are earnest in their desire to see it universally applied, and the Cartesian and other methods completely overthrown.

MAUMATHA NATH RAY.

Calcutta Mathematical Society, Senate House,
March 2.

This method of approach to the quaternion vector analysis is practically that adopted by Prof. Joly in his "Manual of Quaternions." The method is unsatisfactory, because it makes too great a demand at the outset upon the learner's faith. Why should $S\alpha\beta$ be put equal to $-ab\cos\theta$? The answer is, of course, because that is the simplest way of getting a vector algebra applicable to Euclidean space, and at the same time associative in its vector products. But the existence of so many varieties of non-associative vector algebra shows how absolutely unimportant this latter consideration is to many who find vector analysis useful. In these varieties not only is there no explicit recognition of a quantity $\alpha\beta$, where α and β are vectors, but there is a perfect hatred of the mere suggestion of it as a quantity worthy of general discussion, except (be it noted) in the particular case in which α is perpendicular to β. Mr. Ray shows, by a simple Cartesian process, how easily we may arrive at the recognition of this product if we start with the geometrical definitions of Hamilton's $V\alpha\beta$ and $S\alpha\beta$. But the method is unconvincing to the man who prejudges the whole matter by barring out the quantity or symbolic form $\alpha\beta$ as being fundamentally foreign to any well-regulated system of vector analysis! If they would not listen to Hamilton, Tait, or Joly, will they listen to any other quaternionist, charm he never so wisely?

C. G. K.

An Abnormal Zebra.

In reference to the note by Prof. Ridgeway on a photograph of a zebra, or boute-quagga, skin from the Athi Plains of British East Africa, published in NATURE of April 20, I write to say that a copy of the same photograph was received at this museum from Mr. Woosnam.

As I have mentioned in a note in *The Field* of April 22, Mr. Woosnam stated that there were only one or two of such abnormally marked animals running in a herd of *granti* at any one time. It is therefore clear that there is no ground for regarding the variation as of racial value. On this point Mr. O. Thomas, to whom the photograph was sent by Mr. Woosnam, is in complete accord with myself.

R. LYDEKKER.

British Museum (Natural History), Cromwell Road,
London, S.W., April 24.

A Robin and his Young.

LAST summer a pair of robins built their nest in an old fish-basket that was hanging in a shed at the back of my house. All went well until the young birds were about a week old—then happened what appeared to me to be a catastrophe. My Aberdeen terrier pup "Bebe," who must have had some natural desire to catch the mother bird, managed one morning to make a meal of her.

Contrary to what I should have expected, the male bird kept close to his young family. Day by day I turned over part of the garden to supply him with a little help in his task. In due course he taught the whole of his young family to fly.

I have made inquiries, but cannot find anyone who has had a similar experience, and wondered what your readers might know about such cases.

CHARLIE WOODS.

"Vectis," 2 Wellmeadow Road, Lewisham, S.E.,
April 18.

PROPOSALS FOR THE REFORM OF THE CALENDAR.

THE importance of a uniform and simple calendar is not a question which affords any ground for dispute. Whether regarded from the point of view of the chronologist, striving to evolve order out of regnal years and intercalary months, or from that of a business man in Cairo, transacting affairs with clients who adhere severally to the Moslem, the Coptic, the Hebrew, the Julian, and the Gregorian calendars, the diversity of system from time to time, from place to place, and between creed and creed, is an exasperating and unmixed misfortune. The New Year festival is celebrated by the motley races which go to make up the population of Singapore on dates which extend over several months. In Constantinople, until quite recently, even the division of the day was a source of grave inconvenience, since the day ended at local sunset. The persistence of such anomalies shows how hard is the way of the reformer. Tradition and religious scruple, and even the mere inertia of custom, are leagued against him. From the point of view of the whole world, a far greater advance would be made by any large step towards the adoption of one universal calendar than by making small theoretical improvements in a par-

ticular system, however important that system may be. Whatever happens, it is certain that the Gregorian calendar in its main features will survive. For this reason alone its reform is not to be lightly undertaken. A universal appeal can only be based on fixity of tenure as a necessary condition. The French Republican calendar should at least be useful as an awful example. Even the Chinese are considering the advisability of eliminating the lunar element from their calendar and following European practice. Hence changes in our calendar can only be admitted after their necessity has been absolutely proved, and then only with the utmost deliberation. It is not a matter in which a false step can be easily retraced.

It is an unfortunate fact that a calendar of ideal simplicity is precluded by the nature of things. Much difficulty would have been avoided had the tropical year, the synodic month, and the mean solar day been commensurate periods of time, and if, moreover, the number of days in a year had contained certain simple factors. With the Julian calendar, it is true, the lunar month has been placed out of consideration. But the week remains as a fundamental unit of time in human affairs. If only the year had contained 336 days, absolute simplicity would then have been attainable. We should then have had four equal quarters of three months each, each month containing exactly four weeks. As things are, we must be content with something less simple, and, even so, commensurability between the year and the week can only be obtained by placing one day (or two days in the case of leap year) outside the ordinary run of the calendar. This is the suggestion of Mr. Philip, of Brechin, who has proposed that the first day of the year should be thus set aside under the name of New Year's Day, while in leap years a second day of the same kind should be intercalated between the months of June and July. The idea is not, of course, original in principle, for it was used by Auguste Comte in a slightly different way, and has been attributed to Littré. It offers the only means of avoiding a change in the calendar from year to year, and is to this extent attractive. But it has the great disadvantage of introducing discontinuity at the very point where continuity has been preserved in the face of many other changes. The week can boast a most ancient lineage, uninterrupted by the slightest break. Prejudice in its favour must be anticipated, and weighty reasons must be adduced if this feeling is to be overcome.

It has already been pointed out that nature is greatly to blame for not having given us a year of exactly 336 days. Even when the one or two inconvenient extra days have been specially provided for, there remain over just 28 days, and it is in the disposal of these that the calendar reformers have expended their ingenuity. Comte's plan was simply to form them into a thirteenth month, with the extra days at the end of the year. Apart from the peculiar nomenclature in which his philosophy found expression, it is far from clear that this plan has been improved upon by contemporary reformers. The only drawback seems to lie in the introduction of an extra month, and in the fact that a quarter must contain three months and an additional week.

Another proposal is that of Mr. T. C. Chamberlin, which was fully described in these columns (February 2). This consists in dividing the 28 days into four special weeks placed at the end of each quarter. That this scheme should appear rather crude is not unnatural, and to this extent stronger support may be expected for a plan proposed by Mr. John C. Robertson at the fourth International Congress of Chambers of Commerce held in London in June of last year. This would incorporate the extra weeks in each third month, so that each quarter would consists of three months, containing respectively 28, 28, and 35 days. In this way each month would begin with a Sunday, but it is far from certain that the advantage thus gained would be generally regarded as a fair equivalent for the patent disadvantage involved in the disparity between the months. It would appear that approximate equality was more important in the months than in the quarters.

This consideration seems to have had weight with those responsible for the Calendar Reform Bill presented to Parliament by Mr. Robert Pearce. The Swiss Government, at the instance of the London Congress of Chambers of Commerce already mentioned, has invited an international conference on the subject of the calendar, a proposal now receiving the attention of the British Government, and the Bill is intended as a basis for imperial conference. It is proposed to divide the reduced year of 364 days into four similar quarters, each containing three months of 30, 30, and 31 days respectively. With twelve months no better approach to equality is possible. Moreover, the calendar becomes fixed, in the sense that any given date will fall on a particular day of the week, *e.g.* Christmas Day will always be on a Monday. But there will not be that simple correspondence between the day of the month and the day of the week provided by the other schemes. In practice it will be just as necessary to consult an almanac as at present, and the only difference will be that the almanac will be the same for every year. Is this an appreciable benefit? Almanacs are so common, and so often distributed gratuitously, that few people would probably feel the change from year to year, were it not for a circumstance which has purposely been left for separate consideration. As a matter of curiosity, it may be noted that the Royal Academy of Sciences at Stockholm receives a considerable income from a monopoly in the sale of almanacs.

The circumstance just alluded to is the varying incidence of Easter. Owing to the public holidays associated with this festival, and for other reasons, the desire for a fixed date has been very generally felt and often expressed. The Western Church has followed the ecclesiastical moon as defined by the Council of Nice, and the time seems ripe for removing this last remaining vestige of a lunar cycle from our calendar. It is understood that the Pope has raised no objection to this being done, and it is not to be supposed that the other churches concerned will prove "katholischer als der Papst" in this matter. The German Reichstag will be asked to pass a resolution in favour of the appointment of a definite Sunday on which Easter shall be celebrated. The Bill before Parliament proposes that April 14 shall be Easter Sunday. The fixing of this festival is an integral part of the schemes described above for reforming the calendar, and will engage the attention of the diplomatic conference proposed by the Swiss Government. The precise date must be fixed by international agreement, and the mere verbal definition of the date will naturally be facilitated if a fixed calendar has been previously adopted. But the two questions are essentially independent, and Easter can be fixed with all the precision required for practical purposes without any change in the present calendar. Thus if Easter were defined as the Sunday following April 10, it would never be more than three days from April 14, and would fall automatically on the latter date if the scheme now before Parliament were afterwards adopted. But other dates will probably be suggested for consideration.

The internal arrangement of our calendar is in the

nature of things a compromise, and the divergence between the schemes which have been brought forward proves that the reformers are by no means of one mind. The ordinary man does not seem impressed with the necessity for a change. It is alleged that the business man feels some inconvenience, but the English accountant would surely gain far more benefit from a decimal currency than from a fixed almanac. Meanwhile the Board of Trade is very properly taking steps to learn the opinions of the merchants and traders of the country.

It is, of course, mere child's play to invent a calendar. The objection to interrupting the consecutive run of the weeks must be strongly felt. One wonders therefore that none of those who appear to be so much impressed with the advantage of subdividing a year of 364 days have not, so far as we are aware, suggested another plan for getting rid of the superfluous days. This could be done by using the week instead of the day as the unit of intercalation. We begin by allotting 364 days to the common year. We then add at the end of every fifth year (the date ending with 0 or 5) a special "leap" week. This in itself would make the year on the average too long. We therefore omit the "leap" week every fifty years, when the date ends in 25 or 75; and, further, we omit the week at every century which is divisible by 4 (the reverse of the Gregorian rule). The result is to add 71 weeks or 497 days in 400 years, thus making the average length of the year 365·2425 days, or exactly the same as the mean Gregorian year. The special week would probably be found a nuisance, but it would only come once in five years, and it has been seriously proposed to introduce four such weeks into every year! Of course, under this plan, the date of the equinox would wander eight days on either side of the mean date. At the sacrifice of simplicity it would be more correct to intercalate eleven weeks in each successive period of 62 years, at the intervals:

6,6,5, 6,6,5, 6,6,5, 6,5 years.

By this rule the equinox would be kept within four days of a given date, while the mean length of a year would be slightly more accurate than in the Gregorian system. Such a variation from the mean date would not be likely to constitute a practical objection. The idea, however, is only suggested in order to illustrate the unexhausted possibilities which lie before the would-be calendar reformer.

H. C. P.

THE UNVEILING OF NUBIA.[1]

LESS than four years ago practically nothing was known of the true history of that stretch of the Nile Valley, immediately above the First Cataract, which is known to us to-day as Nubia, beyond a few ancient Egyptian stories of raids and conquests, and the tales, often enough fantastic and unreal, of Greek and Roman tourists. In one brief winter's work (1907–8) Dr. Reisner and his collaborators have changed all that. For they have recovered from the soil of Nubia the materials for reconstructing the main phases of the history of that country's strange vicissitudes during the last fifty centuries, as well as a great mass of precise information concerning that crucial period in her evolution, when, about twenty-seven centuries before the Christian era, she began to lag behind Egypt and take her own wayward course, which earned for her the ancient byword "wretched" Nubia.

It has now been demonstrated that in predynastic times, *i.e.* before Upper and Lower Egypt became united under Menes, the first king of the first dynasty (*circa* 3400±100 B.C.), and until the end of the third dynasty (*circa* 2700 B.C.), Egypt and Nubia were culturally (and, as is shown in vol. ii. of this report, racially also) one territory; but, from the time roughly corresponding to the beginning of the period of the Pyramid-builders in Egypt, the histories of the two countries began to diverge the one from the other, Egypt advancing by rapid strides towards national greatness and the attainment of her highest artistic and architectural triumphs; while Nubia was not able even to maintain the old standard of archaic culture, for her people lost their cunning at the same time that their racial purity became tainted with negro blood.

In the time of the Middle Kingdom (*circa* 2000 B.C.), when Egypt for a second time was raised on the crest of a wave of prosperity, Nubia also felt the same influence, and began to exhibit marked signs of progress and the attainment of a distinct individuality; then for the first time her people began to manufacture wares that were not merely inspired by Egypt or imitations of Egyptian workmanship, but deserve to be called Nubian. And if it be admitted that the Nubian arts and crafts show obvious traces of their derivation from the archaic Egyptian, it is also clear that they were developed in a manner strikingly different from those found in Egypt in dynastic times. In the first products of these distinctively Nubian arts we can detect, as also in the remains of the people who made them, an underlying stratum of predynastic Egyptian influence, modified by negro admixture, but evolved in a manner quite distinctive of and confined to Nubia.

Egypt and Nubia each went its own way and evolved along the distinctive lines they had respectively chosen, until a time shortly before the inauguration of the New Empire in Egypt. The passing of Egypt under the sway of the Asiatic Hyksos domination had the effect of driving many Egyptians into voluntary exile in Nubia; this led to a displacement of the Nubian population southwards; characteristic Egyptian graves, containing Egyptian wares and the remains of Egyptian people, made their appearance in Nubia at this time; and evidences of Egyptian occupation of the country were abundant throughout the period of the New Empire.

But when Egyptian power began to wane, the Nubians came into their own once more; but as they returned from the south strangers accompanied them, and, ever after this event, from time to time there were incursions of aliens into Nubia; sometimes tall, Dinka-like negroid warriors, with their own distinctive burial customs; later still, Egyptians of the Ptolemaic and Roman periods occupied Nubia and left the characteristic evidence of their stay in the country, as well as the bodies of criminals of non-Nubian type—perhaps the notorious Blemmyes of the Eastern desert, the mysterious people to whom the classical writers so often referred—whom they had executed; then again, in the early centuries of the Christian era, but before the introduction of Christianity into Nubia, another group of Negroes came north into Nubia, and in the graves of their dead buried their own distinctive pottery, which is neither Egyptian nor Nubian; and in Christian times aliens from Syria and western Asia took refuge beyond the First Cataract.

Nubia was ever a poverty-stricken land; to add to her natural disabilities, her geographical position rendered her liable to be overrun by all these alien hordes, and made her the meeting-place of Egyptians and Negroes and the cockpit where they fought.

[1] "The Archæological Survey of Nubia. Report for 1907–8." Vol i., Archæological Report. By Prof. G. A. Reisner. Pp. v+373+330 text-figures. Plates and plans to accompany vol. i. Pp. 24+73 plates+xxx plans. (Cairo: National Printing Department, 1910.) Price 2 l.e.

This distressful country well earned her ancient title, "wretched Nubia."

In the report of the archæological survey of Nubia there is presented a complete and impartial description of all the historical material thus rescued from the soil, critically sifted, arranged in chronological order, tested by Egyptian criteria, and explained and interpreted.

But in this volume Dr. Reisner has done something more than recover the lost history of Nubia, wonderful as is such an achievement in one short season's work, for he has also given the first adequate and trustworthy account of the earliest stages in the evolution of Egyptian civilisation. It is true that this has often been attempted by other writers: but in all cases fact has been so interwoven with fancy that the pictures painted have been more or less distorted travesties of the truth. Dr. Reisner's report will ever bring the work to the triumphant issue presented in this report. This is no mere idle compliment to Dr. George A. Reisner, assistant professor of Harvard University, who was chosen for this work; for he had a far more exact and intimate knowledge and experience of digging in Egypt such sites as were of crucial importance in Nubia, and had learnt thereby to appreciate the fine distinctions that enabled him to discriminate between archaic burials closely related in time, the one to the other, and to realise the early stages in the divergence between Egyptian and Nubian burial customs before they became obtrusive. It was the possession of this special knowledge that determined the issue in Nubia; and no impartial observer can deny that Dr. Reisner was the man most highly qualified to undertake this work.

No one who was privileged to witness the excavation of the first site dug in the course of this survey

FIG. 1.—The aspect of Nubia near Dabod during the inundation by water held up by the Aswan Dam. From "The Archæological Survey of Nubia."

remain a storehouse of accurate information concerning the springs of Egyptian civilisation, and a work of fundamental importance to all students of the beginnings of culture in other lands.

In the preface to this volume Captain H. G. Lyons, F.R.S., formerly director-general of the Egyptian Survey Department, now lecturer in geography at Glasgow University, explains why this survey was undertaken, and describes the measures adopted to make it as thorough and searching as possible; but he does not tell the reader that to him belongs the credit of initiating and organising the excellent plan of campaign in Nubia.

When Captain Lyons was entrusted with the task of arranging for carrying out the proposed survey, he was singularly fortunate in securing probably the only archæologist competent (in the sense that his training and experience specially fitted him to cope successfully with the tangled problems of Nubia) to (see chapter iv.) can fail to realise the enormous difficulties that had to be overcome before even the alphabet of Nubia's history could be read, and that these difficulties were eventually resolved only by the employment of the most rigorous scientific methods and painstaking analysis of a complicated mass of data, and by the command of an exceptional knowledge and experience to explain them.

In the vast plain surrounding the southern terminus of the Egyptian railroad at Shellal there had been buried the remains of people who had died at every historic period during the last fifty centuries, not only in graves of known Egyptian forms, but in a variety of then unknown Nubian and Sudanese types. Every kind of confusing element was present to complicate the problem: cemeteries of one period intruded in those of earlier date, so that graves of the most varied periods and peoples were apparently inextricably intermingled; the results of the plunder-

ing of graves, both in ancient and modern times, added to the confusion; and the denudation of the plain by the forces of nature in ancient times had destroyed many, and seriously damaged still more, of the graves. The failure to reduce this chaos to order would have gone far to sterilise the essential work of the survey. The results obtained at Shellal gave Dr. Reisner at the outset the whole history of Nubia in epitome; and all the work since accomplished farther south during the last three years has confirmed the accuracy of the conclusions drawn from the study of "Cemetery vii.," while filling in the details of the story that it summarised.

One of the factors that greatly enhances the significance of this report cannot be appreciated without some reference to Dr. Reisner's work before the Nubian survey began. After acquiring a knowledge of Oriental work in Harvard University, he had studied Babylonian and Egyptian philology and archæology, and contributed to the work of cataloguing the collections in the Berlin and Cairo Museums; then in 1899 he began excavating in Upper Egypt as head of the Hearst Expedition of the University of California, and in 1903 at the Giza Pyramids, at first for California, but later, from 1905 onward, for the Harvard University and the Boston Museum of Fine Arts.

During these years, 1899-1907, he and his collaborators, Messrs. Lythgoe and Mace, had devoted the whole of their time and energies to the detailed and critical study of remarkably complete series of burials of the predynastic and early dynastic epochs, in the course of which they were able to sweep away a lot of myths concerning the practices of the early Egyptians, which the fertile imaginations of other explorers had created, and to piece together, bit by bit, the accurate information they themselves laboriously gathered. Unfortunately this expedition was so busily engaged in collecting information that its members found time to impart only a very small fraction of their rich harvest to the public ("The Early Dynastic Cemeteries of Naga-ed-dêr, I.," by Reisner, 1908, and "II.," by Mace, 1910). It is this fact that renders the Nubian report of such importance, for in the remarkable chapter vii., Dr. Reisner draws aside the veil from his vast storehouse of knowledge of Egypt's archaic civilisation, and gives us more exact and detailed information of the pre- and protodynastic periods in the Nile Valley than has hitherto been published.

Another important factor that contributed in no small degree to the success of the Nubian excavations was the systematic training which Dr. Reisner's native workmen had received during their nine years' association with him in Egypt; each man had learned to do his allotted task as a matter of habit, and each became a specialist in some branch of the work, such as prospecting for sites, excavating, cleaning graves without touching or disturbing their contents, and doing all the routine work of making a complete photographic record of every stage of the survey. In chapter ii. Dr. Reisner describes these methods, and in the magnificent volume of plates—in itself one of the completest records of archæological research ever issued—will be found ample evidence of the skill displayed by these illiterate Egyptian boys in the practice of the art of photography and the no less difficult task of systematic scientific excavation.

FIG. 2.—The earliest distinctively Nubian pottery. From "The Archæological Survey of Nubia."

In the work of excavation and the examination and recording of the results, Dr. Reisner was assisted by Mr. Cecil M. Firth and Mr. A. M. Blackman. The major portion of this report consists of their detailed and impartial record of every fact brought to light in the course of their work, illustrated by an exceptionally complete series of photographs and hundreds of text-figures. These results are presented in such a form that anyone who wants to draw his own inferences has all the facts presented to him without bias.

In the last three chapters there is a masterly summary of all the evidence acquired during the first season's work in Nubia, arranged and classified, and

compared with the collateral data obtained in the course of Dr. Reisner's work in Egypt.

In an appendix Mr. W. H. Crosthwaite describes the topographical work carried on by himself, Mr. T. D. Scott, and Mr. G. W. Murray, and their maps, printed in the Survey Department, appear in the volume of plates.

There are complete lists of cemeteries excavated, graves, objects found, and an index.

This report deals only with the first season's work. During the second season Dr. Reisner had to relinquish work in Nubia in order to take charge of excavations in Samaria and at the Giza Pyramids; but the first winter's work proved to be so illuminating that Dr. Reisner was able to hand over to Mr. Firth, who succeeded him, a knowledge of the history of Nubia, which has amply been confirmed at each new site. This winter the survey will reach Korosko and be brought to a conclusion.

When the final results are published the Egyptian Government may congratulate itself on having provided the means for completing the most thorough archæological examination of such an extensive tract of territory, as Lower Nubia is, that has ever been undertaken.

It only remains to express the hope that the unique collection of antiquities collected with such infinite care and skill, and constituting a tangible record of the history of Nubia, will receive the treatment they deserve.

G. Elliot Smith.

GERMANY AND THE PROTECTION OF NATURE.

THE German intellect has a wonderful turn for organic science. Its achievements in this sphere are admittedly unrivalled, and the workers may be counted by the thousand. Such names as Hofmeister, Haeckel, Virchow, Weismann, Sachs, Pfeffer, and Verworn are only a fraction of one per cent. of the list. Consider, for instance, the contributions to a single department, as shown annually in Just's "Botanische Jahresberichte." The typical English attitude, on the other hand, to nature, and especially to organic life, is hardly that of sympathetic study. It may rather be described as amused, or patient, condescension. This patronising habit receives its only modification in the case of "sporting" animals, or the more spectacular birds and mammals; and these are but the materials for a "show," *pour passer le temps.* The Press pours out a flood of "nature books," as the factories pour out toys, to amuse the children. Popularisation is the curse of the age. An up-to-date book on any branch of organic science is not to be found. Instead of a regular issue of sane, scientific accounts of progress, we have outlines for the use of schools, or productions the aim of which is the titillation or excitement of the unintelligent by means of the illustrations, if it cannot be done by the text. Work that does count appears not more often than once in a decade. It is consequently soon out of date. Such books, moreover, are generally too encyclopædic, and their allocation to different departments is far from being scientifically impartial. The various meanings of the term "nature" supply a most interesting study: a corollary may be found in the meanings of the term "natural history." If so vague and obsolete a term is still to be used it should connote the science of all nature, as did the good old phrase "natural philosophy."

The practical English instinct also wastes much energy in exploiting the principle of "design" in nature, and in exercising the habit of "drawing a moral." But it is really far more practical to confine the attention to the mechanism of the phenomena, and to leave teleology to metaphysics. Here, and in other matters relating to the study of nature and to the practical application of science, the German intellectual habit can give us a lesson.

It is refreshing to see a great scientific, and veritably practical, movement carried on without any pandering to amusement, pedagogy, or sentimentalism about "nature." This is distinctly the character of the scheme, the progress of which has frequently been noted in these columns, to preserve the natural monuments of Germany. The term comprises the humblest lichen no less than human monuments, such as the Porta Westfalica.

In Prussia the scheme is highly organised and is a State department. Here we see the cooperation of what we should call municipal and district and county councils with, practically, every man of science in the province, and every voluntary society or association. The German Emperor is patron of the committee for the Hohenzollern district. Every square mile of the country is investigated; when anything approaching a "centre," whether geological or ecological, or even for one characteristic species of animal or plant, is found, that centre receives State protection. The protection, it is well to note, is efficient. The maps printed in the first volume of the "Beiträge" show a remarkable list of such centres reclaimed for nature from man.

This volume of 500 pages records the work done in Prussia during the last five years. The editor, Dr. H. Conwentz, has from the commencement been the moving spirit of the scheme, and he is to be congratulated on a remarkable record of success. But, as we have tried to show, the ultimate factor in this success is the German scientific spirit, which here has the advantage of cooperating with patriotism. It will deserve still more of humanity if its example in this matter is able to inspire other countries.

A large proportion of the volume is occupied by reports, now collected, which were noticed in Nature on their first appearance. The most noteworthy of the new matter is a long and very interesting account of the parallel movement in Denmark, with which the distinguished botanist, Prof. E. Warming, has had much to do. Even a country like Denmark is full of interesting centres of wild nature. The protected colony of *Sterna anglica* is particularly noticeable. The lengthy report of the second conference for *Naturdenkmalpflege* in Prussia, held at the end of 1909, reveals a remarkable combination of enthusiasm and organisation. What especially appeals to us in the whole scheme is its thoroughness and comprehensiveness. We read of a score of "bird reservations," and we find that the protection is more than a mere name. We also read—and to the English mind it reads very strangely—of State-protected wild flowers. Of protected landscapes, "beauty spots," Prussia has about forty: bits of geological interest number, so far, about thirty. What are significantly styled the "remains" of the plant-world and the animal-world are fairly numerous, but we should suppose the lists to be capable of considerable extension. The foreign reader may desiderate the Latin name in every zoological and botanical species cited. This is not always given, and the disentangling of identity from popular German terms is not easy.

[1] "Beiträge zur Naturdenkmalpflege." Edited by Prof. H. Conwentz. Erster Band. Pp. xi+510. (Berlin: Gebruder Borntraeger, 1910.) Price 10 marks.

A very precarious but highly interesting operation is that of assisting the development and propagation of wild creatures and wild plants in their natural homes. Some observations have been made on the subject now and again, and a few isolated experiments are on record, already suggestive of remarkable correlations between development and environment. The principles behind such correlations are wide reaching, and, as ecology has begun to show, of great practical importance. In due course, no doubt, the German scheme will include such experiments, care being taken to prevent that very easily obtained result, the absolute extinction of a species.

A. E. CRAWLEY.

THOMAS RUPERT JONES, F.R.S.

BORN in Wood Street, Cheapside, on October 1, 1819, Rupert Jones, after a long and eminently useful geological career, passed away in his quiet retreat at Chesham Bois on April 13, in his ninety-second year. His father, a silk merchant and throwster, had business premises in Taunton as well as in London, and Rupert Jones spent his early years in Somerset, receiving school education at Taunton and Ilminster. There the fossiliferous beds of the Lias attracted his attention, and the bent of his mind was directed towards science rather than commerce. In 1835 he was apprenticed to a surgeon at Taunton, and he completed his service at Newbury. Geology absorbed all his spare time, and many of his early observations in the neighbourhood of that Berkshire town were published in a pamphlet in 1854. After 1842 Rupert Jones was engaged for some years, chiefly in London, in medical practice. Familiar with the use of the microscope, he applied it with signal success to the study of fossil microzoa. His researches now brought him into contact with William Harris, of Charing, who had gathered a fine collection of Chalk fossils, including the minuter organisms. That geologist also possessed a daughter who became the first wife of Rupert Jones.

In 1849 his monograph of the Entomostraca of the Cretaceous formation of England, his earliest important work, was published by the Palæontographical Society. In the following year he was appointed assistant secretary to the Geological Society of London at Somerset House, where his ability and precision were shown in the editing of the society's quarterly journal. Ever busy, he edited during the years 1854–58 the last editions of Mantell's "Geological Excursions round the Isle of Wight," "Medals of Creation," and "Wonders of Geology." He likewise prepared for the Palæontographical Society further important monographs on the Tertiary Entomostraca (1856), and on Fossil Estheriæ (1862). In 1858 Rupert Jones was appointed lecturer on geology at the Royal Military College, Sandhurst, and four years later professor, when he resigned his post at the Geological Society, and removed to Farnborough, in Hampshire. In association with Dr. Henry Woodward he edited the first two volumes of *The Geological Magazine* in 1864–65, and among other works edited the "Reliquiæ Aquitanicæ" of E. Lartet and H. Christy (1875), and the second edition of "Dixon's Geology of Sussex" (1878).

His special studies were not neglected. He contributed to scientific societies and journals numerous original articles on recent and fossil Foraminifera, and Entomostraca (Ostracoda and Phyllopoda), subjects on which he came to be recognised as the leading authority in this country. Much work, moreover, was done in conjunction with his friends, W. K. Parker, H. B. and G. S. Brady, Henry Woodward, J. W. Kirkby, and others. Thus he received aid in the preparation of the monographs on the Foraminifera of the Crag (1866–97), and on British Carboniferous Entomostraca (1874–84). In 1880 Prof. Jones retired to London as the special teaching of geology at Sandhurst was then abandoned by the military authorities.

His interests extended over a wide geological field, and he had a profound knowledge of the literature. South African geology especially attracted him. In later years he gave much attention to the antiquity of man, and wrote on the plateau implements in 1894. Of sturdy build, though below the average height, he was of a cheery disposition, prone to jocularity, but ever ready to give earnest help to others. Proof-correcting he regarded as one of his recreations. Prof. Jones was elected F.R.S. in 1872, and the Lyell medal was awarded to him in 1890, by the council of the Geological Society. He was president of the Geologists' Association in 1879–81, and president of the Geological Section of the British Association at Cardiff in 1891.

H. B. W.

NOTES.

A MOST important discovery in regard to the existence of man in early Pleistocene or Pliocene strata has been made by the Marquis of Cerralbo in Spain. In the alluvial deposits of the River Jalon, which is an affluent of the Guadalquiver, he has discovered very abundant remains of undoubted *Elephas meridionalis* in contact with well-characterised implements of human workmanship of the proto-Chellean type. Photographs of the specimens and of the cuttings in which they occur have been received from the Marquis in Paris, and Prof. Marcelin Boule left Paris in Easter week in order to examine the site and the specimens. It is possible that *E. meridionalis* may have survived in the south of Europe from Pliocene into early Pleistocene times, but the association of implements of human workmanship with this early species of elephant is altogether new. This discovery tends to confirm the truth of Mr. Moir's contention that the admitted proto-Chellean flint implements discovered last year by him in Suffolk, and exhibited at the Geological Society in the autumn, are really anterior to the Red Crag deposit beneath which they occur. It is to be hoped that Mr. Moir will soon publish an illustrated account of his discovery.

A VERY interesting expedition is about to visit the neighbourhood of Astrakhan. It consists of a party of trained medical observers, provided with all appliances for research, organised in Paris, and under the personal direction of Prof. Elie Metchnikoff. The object of the expedition is two-fold. It will study the history of the endemic foci of plague in the neighbourhood of Astrakhan. The cause of the repeated outbreak of plague in this region, which although usually on a small scale is of almost regularly annual occurrence, will be investigated in the light of our present knowledge of the relation of rat-like animals and fleas to plague. A second object is to investigate the causes of the singular difference of susceptibility to phthisis presented by the Calmuck Tartars and the Russian town population. It appears that the Calmucks when living their usual nomadic life in tents are free from phthisis, yet when young Calmucks (semi-adult) are brought into the towns to be "educated," they invariably contract phthisis and die. What is the reason of the less susceptibility of the Russian town population? Is it due to immunity conferred by other microbes than that of tuberculosis which have escaped detection hitherto, and

are not present in the Calmuck communities, though regularly infecting and "immunising" the Russian town-dwellers in childhood?

The death is announced of Dr. A. J. M. Bentley, distinguished by his knowledge of tropical diseases and as the author of "Beri Beri, Its Etiology, Symptoms, Pathology, and Treatment."

The death is announced, at sixty-six years of age, of Dr. B. S. Ringer, formerly medical officer to H.B.M. Consulate-General and the Chinese I.M. Customs, Canton, China, and the discoverer in Formosa of a parasitic worm known as *Distoma ringeri*.

The Astronomical Society of France has just elected the following officers:—President, M. P. Puiseux, astronomer to the Paris Observatory; vice-president, Prince Roland Bonaparte; general secretary, M. Camille Flammarion; secretary, M. Jean Mascart; and treasurer, M. Maurice Ballot.

The Christiania correspondent of *The Times* states that on April 20 a Bill was brought forward providing for the necessary grant for wireless telegraphy stations at Hammerfest and Spitsbergen. The Spitsbergen station will be kept open all the year round, and will be in charge of three or four men. The distance from the Hammerfest station is 750 miles.

A fund has been opened for the purpose of presenting a testimonial to Mr. Henry Keeping, who has been for fifty years curator of the Geological Museum, Cambridge, and is now retiring from active work. There are probably many who will welcome this opportunity for expressing their appreciation of Mr. Keeping's long service in the cause of geology. Subscriptions should be sent to Mr. F. R. Cowper Reed, Sedgwick Museum, Cambridge.

A new system of wireless inductive telephony was inaugurated at Stratford-on-Avon on Thursday last, when Mr. H. von Kramer's "railophone" was tested on a train belonging to the Stratford-on-Avon and Midland Junction Railway. Two large frames—or coils—of wires are attached to the carriages, one being used for despatching messages and the other for receiving same. By means of induction between these coils and a wire running along by the side of the metals, but some distance away, and connected to instruments in the signal-cabins, messages can be received and despatched whilst the trains are in motion or standing. The test was successfully carried out, and a party of journalists and others were conveyed in the train for several miles, receiving or sending messages whilst *en route*. Eventually it is proposed to connect up the signal-cabins with the general telephone and telegraphic systems, thus making it possible to send and receive messages and telegrams to or from places far away from the railway whilst still in the train.

News of Captain Amundsen's Antarctic Expedition has been brought by Captain Nilsen, commanding the *Fram*, which arrived at Buenos Ayres a few days ago. It appears from a Reuter message that Captain Amundsen arrived in Antarctic regions on January 14, and the ship dropped anchor safely close to a comparatively elevated coast. Camp was established on a hill near where the *Fram* was moored, and preparations were begun for a journey to the Pole. The *Fram* sailed on February 14, before Captain Amundsen had started for the south. In a few weeks the vessel will leave Buenos Ayres for scientific work during a voyage between Africa and South America, and will then return to Buenos Ayres to renew her stores. Captain Nilsen expects to be able to leave Buenos Ayres on October 1 in search of Captain Amundsen and his party.

The death is announced of M. Edouard Dupont, director of the Royal Museum of Natural History in Brussels, and well known for his researches in many departments of geology. An appreciative notice by M. Cornet appears in *Le Mouvement Géographique* for April 9. M. Dupont was born at Dinant on January 31, 1841, and died at Cannes on March 31 of the present year at the age of seventy. His work in connection with the preparation of a geological map of Belgium is well known in the British Isles, and the complete skeletons of Iguanodon, discovered in the clays of Bernissart, were set up in the museum in Brussels under his care. While the palæontological collections were extended through his personal studies, he paid attention also to the stratigraphical conditions under which the rocks of Belgium were laid down. His researches were especially directed to the Carboniferous Limestone, in which he recognised a coral-reef type and also calcareous fragmental deposits of a pelagic character. In 1887 he made an expedition at his own expense to the Congo territory, the results being published in a book entitled "Lettres sur le Congo," in which geological, botanical, and anthropological observations were happily combined.

The experiments of Mr. Glen Curtiss with his hydro-aëroplane have culminated in the production of a machine capable of running over land and travelling on the water with the same facility with which it rises from either of these elements into the air. His original model was fitted with two floats, a water-shield, and a large pontoon, but in his latest production only a single pontoon is used. This pontoon is rectangular in plan, 12 feet long, 2 feet wide, 1 foot deep, and 50lb. in weight. Its under surface curves up to meet the upper surface 3 feet from the front edge; similarly, its upper surface curves down to meet the under surface 3 feet from its rear edge. The aëroplane itself is of the usual type of Curtiss biplane, and carries under each extremity of the lower plane a skid, 4 feet long, to prevent the plane tips touching the water when turning upon it. Wheels are fitted in front and behind the pontoon. The aëroplane has made many successful flights at San Diego Bay (Cal.), rising easily into the air, and after flights gliding down to water, upon which it alighted without a splash. The diminution of speed caused by the head-resistance of the pontoon, which, as will be understood, does not possess the stream-line form, is said to be about five miles an hour.

Dr. Petrie's discovery, which is reported in *The Times* of April 15, that the marmot is the host of fleas of very large size, may prove of considerable importance in connection with the study of the epidemiology of plague in Manchuria. Although it appears highly improbable that an epizootic has played any part in the outbreak in Manchuria proper, there is ample confirmation for the hypothesis that, in regions further west, the epidemic is derived from marmots. These animals, locally known as "tarbagans," are hunted for their skins. The occurrence of plague epizootics among them has been recognised for some years, but it is not known what form the disease takes, nor how it may be transmitted to the hunters. This demonstration of the existence of the marmot flea indicates a possible link in the chain of infection, and it is not improbable that future investigations will show that, in Manchuria, the marmot flea may to some extent play the same part as the rat flea in India. In the meantime, it cannot be said that this discovery brings us much nearer

to an explanation of the epidemic in Manchuria. No adequate reason has yet been found for the wide dissemination of the disease, at a season when few fleas of any kind are to be encountered. The appearance of the disease in a pneumonic form of exceptionally high virulence affords also a problem which still requires an answer. Although the Chinese epidemic has attracted so much attention, it becomes almost insignificant when compared with the ravages of the disease in India. Prof. Simpson, in a letter to *The Times* of April 17, directs attention to the enormous plague mortality in the United Provinces of Agra and Oudh, districts of which the joint population is little greater than that of the British Isles. Upwards of 72,000 persons died of plague in these provinces during March, and in the week ending March 25 the number of deaths reached the appalling figure of 22,000.

The number of Easter vacation workers at the Port Erin Biological Station has this year, for the first time, exceeded fifty. The universities and university colleges of Birmingham, Cambridge, Cork, Liverpool, Manchester, and Reading are represented by members of their biological staff or by senior students; and the researchers include:—Prof. B. Moore and Mr. E. Whitley (bio-chemistry), Mr. Walter Tattersall, and Mr. E. W. Shann from Manchester, Prof. Cole from Reading, Mr. Douglas Laurie from Liverpool, a group of botanists—Prof. Harvey Gibson (Liverpool), Mr. J. C. Johnson (Cork), and Mr. R. H. Compton and Mr. S. Mangham (Cambridge)—working at algæ, a group of planktologists from Liverpool, including Mr. W. Riddell, Dr. W. J. Dakin, Prof. Herdman, and others. The new wing of the Biological Station, which was erected last winter, is now fully occupied by the researchers, and the larger laboratory is crowded with senior students. If numbers continue to increase, a further extension in the near future will certainly be required. The fish hatching is proceeding as usual. The first fertilised eggs of the plaice appeared in the spawning pond this year on February 13, but after that the cold, tempestuous weather seemed to delay the spawning, as the total numbers passed through the hatching-boxes up to date (April 20) are behind those of last year. The number of visitors to the aquarium of the institution is, however, considerably in advance of last year. Periodic observations on the plankton at sea are being taken from Prof. Herdman's yacht *Runa*, and the outstanding fact in this season's work, so far, is that the diatoms are unusually scarce and late. The vernal phytoplankton maximum has not yet arrived.

In the Australian monthly, *The Lone Hand*, for February, Prof. J. Macmillan Brown discusses the question of the White Gods of Ancient America. He points to the singular fact that among the races of the Isthmus there is a large sprinkling of blonde-haired, blue-eyed, European-like men and women, whose origin is not to be explained by the theory of descent from the white emigrants of later historical times, this more recent European type being rapidly modified by environment and miscegenation, and quickly disappearing. He also refers to legends of the arrival in America of bearded white strangers, like Manco Capac. These stories, like the stone culture, are mainly confined to the Pacific littoral and the neighbouring mountain ranges. To explain these facts Prof. Brown postulates a Polynesian, that is to say, ultimately a Caucasian, immigration which passed northwards from Peru, from which direction he assumes that the culture represented by the Palenque ruins and that of the Astecs had its origin. It can scarcely be said that the facts which he has collected prove his theory; but the problems of the origin of Central American civilisation are so perplexing that this suggestion deserves consideration.

Hitherto it has been generally believed that the paper read before the Society of Antiquaries in February, 1785, by W. Marsden, entitled "Observations on the Language of the People commonly called Gypsies," in which, from materials collected in 1783–4, he announced the similarity of Romani to some Indian dialects, was the first publication of the fact in this country, though it had been anticipated on the Continent by Rüdiger and Grillman. In *The Gypsy-Lore Journal* for January, Mr. J. Sampson advocates the prior claims to this discovery of Jacob Bryant, the author of that fantastic and now wholly useless treatise on mythology, "The New System, or an Analysis of Ancient Mythology." At the meeting of the Society of Antiquaries in the April following the receipt of Marsden's communication, that of Bryant, "Collections on the Zingara Gypsey Language," was read. The glossary of Bryant has now little value, and abounds in curious mistakes; but Mr. Sampson proves that the material was collected at least as early as 1776; and, if this be so, Bryant has the honour of having anticipated not only Marsden, but also the Continental philologists in this remarkable discovery.

In the January number of *The Gypsy-Lore Journal*, Mr. D. F. de l'Hoste Ranking begins a useful analysis of the account of the beliefs and sociology of the Gypsies of Central Russia recently collected by Mr. V. N. Dobrovolski. This branch of the Gypsy race strongly insists on its Egyptian origin, and even assigns to Pharaoh the useful invention of the "jemmy," which enables them to tackle modern locks. They are on a much higher plane, as regards intelligence and culture, than the peasantry among whom they live. They possess, for instance, an elaborate system of defining time by the motions of the stars, a survival of their primitive nomadic life. Their most cherished possession is the whip, and the association of it with the marriage customs of the tribe, which Mr. Ranking suggests to be connected with marriage by capture, is more probably intended to expel the evil spirits which beset the bride and bridegroom at this crisis of their lives. The use of the doll in the betrothal rites seems to be based on a mimetic fertility charm. Their polytheism has now widely absorbed the national reverence for the ikons; and another form of magic includes the use by thieves of a candle made of a dead man's fat, the "Hand of Glory" of the "Ingoldsby Legends." Mr. Ranking suggests that the *provenance* of this last superstition may form an important link in the chain of evidence which may solve the problem of Gypsy origins, and he pleads for special inquiries regarding this belief.

Messrs. E. Leitz have issued a very useful pamphlet on the microscope and how to use it. The path of the rays, the meaning of aperture, resolving power, illumination, eye-pieces, and focussing are all briefly but fully explained, the text being illustrated with many excellent diagrams.

The Eugenics Review for April (iii., No. 1) contains an interesting and suggestive article, by J. H. Kohlbrugge (translated from the German by J. H. Koeppern), on the influence of a tropical climate on Europeans. It is pointed out that no white race has been able to survive in the tropics unless race-mixture has taken place, and as the white races cannot become really acclimatised, and as it is doubtful whether we can achieve satisfactory results by race blending, it is concluded that we can neither take the place of the native nor do without him

Miss Chick and Dr. Martin give an interesting summary, with new experiments, on the readiness with which various rat fleas bite man (*Journ. of Hygiene*, xi., 1911, No. 1). The matter is of importance with reference to the spread of plague. They find that the common rat flea of temperate regions (*Ceratophyllus fasciatus*) readily bites man. Two more specimens of *Xenopsylla cheopis*, the common rat flea of India and other parts of the tropics, have been captured by Dr. Boycott at Guy's Hospital. Only one specimen of this flea has hitherto been recorded in England. The destruction of fleas by exposure to the sun is dealt with by Captain Cunningham, I.M.S., in No. 40 of the Scientific Memoirs of the Government of India. It is found that in the hot sun of India fleas die in about forty-five minutes, the result being chiefly due to the heat rays.

To Mr. F. L. Dames, of Berlin, we are indebted for a copy of "Bibliotheca Entomologica," a classified catalogue of entomological works and papers for sale at his establishment, containing, in this instance, 7633 items.

We have to acknowledge the receipt of a copy of the second number of *The Nature Photographer*, the official organ of the Nature Photographic Society. The feature of this issue is a portrait of a grey wagtail, which is a superb example of live-bird photography.

In our last week's number reference was made to a notice in the *Aarsberetning* of the Bergen Museum, of the recent scientific cruise of the *Michael Sars* in the Atlantic. A fuller and well-illustrated article on the same subject, by Dr. Johan Hjort, appears in *Naturen* for March and April. After an introductory notice of the object and extent of the cruise, attention is directed to the hydrographical results, which include observations on temperature and salinity taken at 110 stations, these being illustrated by maps and diagrams. After a short notice of the plankton, and another of pelagic animals, the deep-sea fishes taken during the cruise receive fuller attention, special interest attaching to the maps illustrating the localities where specimens of Cyclothone, Gonostoma, and Chauliodus were respectively taken.

Writing in his usual picturesque and attractive style, Sir Harry Johnston, in the April number of *The Quarterly Review*, pleads for the preservation of the fauna and flora, not only of the British Empire, but of the world at large. For he recognises that if effective measures are to be taken with this end in view, they ought to be taken without delay, "lest, before we can put in force regulations to save from destruction the rarer and more wonderful and beautiful of living forms on the earth's surface, they may be swept away for ever to gratify the whim or the taste of the uneducated many." Sir Harry puts the case in a very temperate manner, freely admitting that in many districts, East Africa for example, the claims of agriculture must be paramount, and that the wild fauna should be mainly restricted to reserves. In urging that such reserves should not be opened even to personages of the most exalted rank, the author has our full sympathy. Whether he is justified in his belief that the Lado white rhinoceros is even now in peril of extinction, may perhaps be doubtful; but we are in full accord with him in regarding a recent much-advertised slaughter of the species as altogether unjustifiable. That we ourselves are by no means blameless in such matters, is, however, proved by the evidence quoted as to the recent enormous destruction of sea-elephants in South Georgia.

In the February number of *The Cairo Scientific Journal*, Mr. F. Hughes discusses the amount of silt carried by the Nile during the floods of 1908 and 1910. Observations were made near Cairo and at points on the Rosetta branch of the river, and results in parts per million of from 1200 to 2000 were obtained. Some examples were collected from canals of various dimensions, and the reduction of coarser suspended matter in some cases in subsidiary canals was very marked after a short distance.

The Dutch Meteorological Institute publishes a series of observations obtained by means of kites on board ship in tropical latitudes. Forty-one ascents are given, 2360 metres being reached in one case. Naturally the sets of observations at any one place are few, but the material will be of value in connection with such other information as accumulates in these little investigated regions. Pressure, temperature, humidity, and wind force and direction are given.

In the April number of *The Geographical Journal* the positions of nineteen geodetic positions of stations of the Uganda are given. The War Office intend to publish a full account of the operations and calculations connected with this work, and in a second part to discuss the local attraction, based on a comparison between the above positions, and the astronomical latitudes now being computed by the Belgian astronomer, M. Dehalu. The same number contains a reference to Dr. K. Peucker's proposals for the colouring of relief maps, for which aërial locomotion has produced demand. His method is based on the teachings of physiological optics, and there is certainly room for a more scientific and less empirical study of cartography in this country than has hitherto obtained.

A geographical report on the Franz Josef Glacier has been published by the New Zealand Department of Mines. Mr. J. M. Bell, the director, examined the area in 1908 and 1909, a topographical survey of the glacier and its tributaries being made with theodolite and phototheodolite. A number of points were fixed and marked for future reference, for the frontal face of the main glacier is ever changing and it is difficult to determine its general direction of movement; on the whole, it seems to have retreated in recent times, and now stands at a point 692 feet above sea-level. Measurements of a series of points on the glacier surface gave rates of movement of from a foot a day near the side to about double this amount near the centre.

In "Extracts from Narrative Reports, 1907–8," of the Survey of India, are given more detailed results than can be included in the annual report. The diurnal variation of horizontal magnetic force was determined at Trichinopoly, in southern India; and a comparison of the magnetic instruments at Dehra Dun with those which Mr. D. C. Sowers, of the Carnegie Institute, had used while travelling overland from Pekin to Srinagar, was made. Full details of the secular change values for each month are given at each of the four magnetic observatories of Dehra Dun, Barrackpore, Toungoo, and Kodiakánal, as well as hourly means of declination and horizontal force. The section dealing with tidal and levelling operations gives the values of the tidal constants for the eight stations in operation. Binocular American precise levels were used by one party, and were to be used by all parties in the following season, by which change an appreciable increase in the rate of work was attained. In the work of the pendulum party the changes in the times of vibration of each of the four pendulums from 1904 to 1909 are given and discussed.

The Seismological Society of America, which owes its foundation to the interest aroused by the Californian earthquake of 1906, has recently issued the first number of its quarterly Bulletin. Most of the short papers which it contains are devoted to the study of seismology in the United States, to the difficulties under which its prosecution labours, and to suggestions for organised work in the future. Among the papers of permanent interest may be mentioned Mr. H. F. Reid's account of the earthquakes felt in Central New Mexico in 1906 and 1907, and the list of seismographs known to be at work on the American continent, a list which includes no fewer than thirty-five Wiechert pendulums, twenty-nine Bosch-Omori pendulums, and nine Milne seismographs. Prof. Branner, in discussing the relations between earthquakes and the growth of faults, suggests the need for distinguishing between faults which are now active and others which have apparently reached a condition of stability, and he points out the useful work which might be carried out in this direction by the organised study of Californian earthquakes.

The daily and yearly period of rainfall at Trieste is discussed by Dr. E. A. Kielhauser in an interesting paper laid before the Vienna Academy of Sciences in November last, based on eleven years' readings of the self-recording rain-gauge at the observatory (1896–1906). Among the many points referred to we may mention that the rain-curve of the amounts for separate hours shows that it is made up of a large number of waves of short periods. In addition to the most prominent extremes of the absolute maximum (11h.–12h. p.m.) and the absolute minimum (11h.–12h. a.m.), fifteen relative maxima and minima are exhibited. In spring and winter, the hours of 5 a.m. to 1 p.m. are relatively dry, while in summer and autumn they are relatively wet; for the other hours the reverse naturally obtains. At all seasons of the year the duration of rainfall is greatest at night-time. The annual rainfall is 39·7 inches (mean of sixty years, 42·8 inches). The driest months are February, April, December, and especially January; the wettest months are May, June, November, and especially September and October. The driest month of the eleven-year period was February, 1896 (0·07 inch), the wettest, October of the same year (10·7 inches).

The April number of the Journal of the Röntgen Society contains a paper by Dr. W. Salomonson, of Amsterdam, on the induction coil, considered mainly from the point of view of the Röntgen-ray photographer. It is well illustrated by reproductions of photographs of the spark and of the primary current taken with a string galvanometer or an oscillograph. These show clearly that, as the capacity of the condenser in the primary is increased from a very small value, the time taken for the primary current to fall to zero at first decreases, then increases, in agreement with the theory of Mizuno. With an interrupter working in hydrogen or coal gas, the time of fall of the primary current may be reduced to 0·0002 second. Experiments with a new coil, by means of which photographs of the heart and lungs can be taken in 0·01 second, show that the spark is shaped like a corkscrew, and that it passes before the magnetic field due to the current in the primary has disappeared.

To those who are so unfortunate as to have to deal with electrical apparatus which has been flooded, the account of the steps taken by the railway and other companies to clean and dry the apparatus submerged during the Paris floods of 1910, published in *The Electrical Review* for April 14, will prove useful. It is compiled from the report of the Société des Electriciens, which relates to more than a thousand pieces of apparatus which were dried satisfactorily. The apparatus was first washed either with water, or, if battery acid had attacked it, with dilute acid, then water, then weak alkali, then water. If oil had got into the apparatus it was first washed with benzoline. Any method of drying, if properly applied, was found effective. Fixed machinery was dried either by an air blast or by fires underneath, in the first instance, and the process completed electrically. Portable machinery was treated in ovens gas or steam-heated to 120° C. at atmospheric, or to 70° C. at reduced pressure. A 60-kilowatt direct-current generator gave up two gallons of water in the drying process. Storage cells appear to have come through the floods with very little deterioration.

Messrs. Carl Zeiss (London), Ltd., have recently introduced the following novelties in optical instruments:—Mayer's new dissecting microscope has a characteristic form of exceptionally large stage, and can be fitted with either monocular or binocular observing systems. It can also take a stereocamera and drawing apparatus. Zeiss's field-glasses are made in a new form, possessing increased light-transmitting power combined with exceptionally large field. Strict alignment of the lenses is secured by casting the hinges and body in one piece. Telescope spectacles are for extreme myopia (10–20 dioptres), and give a field of more than 40°. For astigmatism a special form is provided. A new level is of small dimensions but of extreme sensitiveness. The bubble is observed by a reflecting prisma, which shows images of the semicircular ends of the bubble. In adjusting the instrument, these semicircles are brought into contact along their diameters. All axes are truly cylindrical. The telescope is hermetically sealed up, and by means of a transferable eye-piece can be read from either end. The instrument is packed in a case about 8 inches by 5 inches by 2½ inches, and the accuracy equals that of a 12-inch or 14-inch level of ordinary type. The Cardioid condenser is for dark-ground microscopical illumination, and is chiefly for studying colloidal matters. It gives a narrow extreme annular illumination the rays of which reunite in the plane of the object. Colloidal gold particles of less than 10 $\mu\mu$ can be seen moving rapidly in a field illuminated with this device. The oral illuminator contains a special arc lamp of 5 amperes fitted with a condensing arrangement for dental and mouth illumination. It is also fitted with a special tinted glass for bleaching the teeth. A new illuminating device for operating theatres consists of a powerful automatic-feeding arc lamp of 30 amperes, throwing a strong beam of light upon a large collecting lens. A system of mirrors breaks up and recollects the light so as to concentrate it free from shadows upon the operating table. The arrangement is, naturally, chiefly useful when surgical operations are performed at night.

In an article on the central buffer-coupling appearing in *Engineering* for April 21, it is stated that there is a distinct tendency towards its adoption in countries where the 5-foot 6-inch gauge is the standard. In India, where there are some 16,300 miles of 5-foot 6-inch gauge line, the standard coupling is causing ever-increasing trouble. On one line, the renewals necessary to replace one year's breakages necessitated the placing of orders recently for 10,000 screw-couplings. As the present standards give a coupling of about the maximum weight which can be handled conveniently by the native staff, it is apparent that relief must be sought either by making use of much more costly material or in making a change in the type of draw-gear. The present trouble arises from the greater hauling capacity of modern locomotives, the extending use of high-

capacity wagons, and the more general application of automatic brakes. It is of interest to note that the central-buffer coupling produces less waste of energy in trains travelling on a curve. Tests carried out in India on a 5-foot 6-inch line showed that the side-buffered stock required an increase of power of 5·82 per cent. on a 40-chain curve as compared with similar stock, but fitted with central-buffer couplings.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MAY:—

May 1. 1h. 11m. Venus in conjunction with the Moon (Venus 1° 29′ S.).
4. 11h. Uranus stationary.
5. 6h. Mercury in Inferior conjunction with the Sun.
11. 16h. 53m. Jupiter in conjunction with the Moon (Jupiter 1° 19′ N.).
12. 17h. 57m. Moon eclipsed, partly visible at Greenwich.
18. 9h. 16m. Uranus in conjunction with the Moon (Uranus 4° 43′ N.).
22. 13h. 54m. Mars in conjunction with the Moon (Mars 2° 19′ N.).
26. 7h. 15m. Saturn in conjunction with the Moon (Saturn 2° 38′ S.).
28. 14h. 28m. Mercury in conjunction with Saturn (Mercury 1° 35′ S.).
29. 14h. 51m. Venus in conjunction with Neptune (Venus 2° 59′ N).
30. 14h. 57m. Neptune in conjunction with the Moon (Neptune 5° 32′ S.).
30. 16h. 50m. Venus in conjunction with the Moon (Venus 2° 35′ S).

COMETS AS MERELY OPTICAL PHENOMENA.—On a plate accompanying No. 4492 of the *Astronomische Nachrichten* there appear reproductions of fifteen photographs, each of which bears a striking resemblance to one or other of the various cometary forms made familiar to us by photographs of comets. But each of these images was produced by passing luminous rays through various lenses in abnormal positions, and the author, Signor Luigi Armellini, of Tarcento, throws out the suggestion that comets may only be optical phenomena produced by the distortion of solar rays passing through lenticular cosmical masses of meteorites. The author does not discuss the spectroscopic side of the question, and the idea is not novel, but the photographs reproduced are so realistic as to make the note of interest.

THE "ASTRONOMISCHEN JAHRESBERICHTS."—Owing to ill-health, Prof. Berberich has been forced to hand over the editorship of the extremely useful *Astronomischen Jahresberichts*, founded by the late Dr. Wislicenus in 1900, to the Astronomische Rechen-Institut of Berlin. In order that the year-book may not suffer by the change, Dr. Fritz Cohn, director of the Rechen-Institut, asks for the cooperation of astronomers who publish any papers during the year. The section on variable and new stars has been undertaken by Dr. Pračka, Observatorium Nižbor, Bohemia, to whom extracts coming under that heading should be sent.

THE INTRINSIC LIGHT AND EFFECTIVE TEMPERATURES OF ALGOL AND ITS SATELLITE.—In a paper recently published in the *Bulletin Astronomique*, Dr. Nordmann discusses the intrinsic brightness and temperatures of Algol and its satellite by a method depending upon a knowledge of these quantities for the sun, and quite independent of his heterochrome photometer method. In the result, he finds that the surface brightness of Algol is about twenty-six times that of the sun per unit area, and that the effective temperature of the star is about 13800°; by the independent photometric method he found 13300° as the temperature.

While the general failure to detect a secondary minimum in the light-curve of Algol suggests that the satellite only emits a negligible quantity of light, Dr. Nordmann's results indicate that the satellite is not the obscure, cool body it is generally supposed to be, but has an effective temperature and a surface brightness of the same order as those of the sun, to which it is about equal in diameter. The temperature found is equal to, or less than, 5730°, and the magnitude is not greater than 5·5. For the sun he obtained a temperature of 5320°, and for γ Cygni, which Lockyer places in the Polarian class, a stage higher than the Arcturian class which includes the sun, he found 5670° by his photometer method, but he concludes that Algol's satellite has a temperature not very superior to that of γ Cygni. Finally, he shows that, alone, the radiation from Algol would probably suffice to maintain the surface of the satellite turned towards the primary in a state of incandescence.

HALLEY'S COMET.—In a letter to *The Observatory* (No. 434, April) Mr. Keeling directs attention to an apparent brightening of Halley's comet early in March. From November, 1910, to February 5, the comet was becoming fainter, from mag. 14½ to mag. 15½, but on March 4 both the visual and the photographic observations at the Helwan Observatory showed it to be much brighter, smaller, and more sharply defined than during the previous four months. Its magnitude, determined from two plates taken on that date, was 14–14½, but it was half a magnitude fainter again on March 8. The Helwan observations show that throughout the long period it has now been observed during this apparition it has been about a magnitude brighter visually than photographically.

At the last meeting of the Royal Astronomical Society Mr. J. H. Reynolds directed attention to the distinct type of tail emanating from the comet on different dates. The Helwan photographs form a very long, connected series, and from them Mr. Reynolds suggests that the type of tail presented depends upon the distance from the sun rather than upon the size of the comet; when near the sun the tail appears as a prolongation of the envelopes around the nucleus, but when distant it takes the form of streamers radiating from a point directly behind the nucleus. Investigations by Mr. Knox Shaw indicate that at distances from 0·4 to 0·7 the tails are of the extended envelope type, from 0·7 to 0·8 they are of an intermediate type, and above 0·8 they are of the radiating type, such as seen in the case of Morehouse's comet.

A continued ephemeris for the comet is published by Dr. Ebell in No. 4492 of the *Astronomische Nachrichten*.

OBSERVATIONS OF JUPITER.—In the April number of *L'Astronomie* M. Antoniadi describes his observations of Jupiter made at the Barbier, the Meudon, and the Juvisy observatories during 1910. Numerous spots, clouds, and disturbances were seen and are described, and it is remarked that the suggestion, made in 1902, that the Red Spot is pushed forward by the great disturbance which overtakes it periodically, was confirmed by the observations made in July; on July 25 the longitude of the Red Spot was 356° instead of 358°. A splendid drawing in colours is reproduced on a plate accompanying the article.

GEOLOGICAL WORK IN BRITISH LANDS.[1]

II.—IN AUSTRALASIA.

THE Geological Survey of Western Australia suffers, like that of India, from the pecuniary attractions offered by mining companies. It thus lost Mr. Brooking at the end of 1909, but hopes to retain other efficient officers. In the Annual Progress Report for that year (issued in 1910), Mr. H. P. Woodward describes an association of albite and tantalite in pegmatite dykes (p. 17) which recalls the famous dyke with rare black minerals at Ytterby. The albite has been removed in one reef and replaced by quartz, furnishing another point of similarity between the Australian example and those of Swedish isles. The Bulletins recently issued rightly devote much attention to mining interests. We are glad to note that Mr. J. Allan Thomson, lately one of the Rhodes scholars from New Zealand, contributes the petrographical matter to No. 33. He provides, among other points, an interesting discussion on uralitic hornblende (p. 132). The mining memoirs, such as this on the Gascoyne and Pilbara Goldfields, and No. 38 (1910), on the Irwin River Coalfield,

[1] The first article appeared in NATURE of February 23, 1911 (vol. lxxxv., p. 553).

are complete in themselves, with colour-printed maps and sections. The responsibility of one officer for each field bulletin probably aids the rapid production of a series in a single year. Mr. Talbot describes in No. 39 (1910) the country traversed on a water-seeking expedition in the interior, between Wiluna, Hall's Creek, and Tanami. We note the occurrence of obsidianites at one point (p. 29). The descriptions and excellent photographs of the country make the bulletin of geographical value (Fig. 1). Four contributors furnish Bulletin 36 (1910), on palæontology, two being English specialists. Dr. G. J. Hinde describes sponge-spicules, the silica of which remains uncrystalline, from a post-Cretaceous rock in the Norseman district. Mr. Newell Arber deals with certain plants, which would determine strata at Mt. Hill and near Mingenew as Jurassic; and Mr. R. Etheridge describes a number of Jurassic marine fossils from the Greenough River district.

FIG. 1.—Jellabra Rock-hole, east of Gardiner Range, on the border of West and South Australia, Devonian Sandstone.

Mr. L. Glauert, of the Western Australian Survey, compares the jaw and teeth of a new diprotodont species, *Sthenurus occidentalis,* found in stalagmite, with the species known to Owen. He then (p. 71) gives a useful systematic list of Western Australian fossils, which must not be overlooked by stratigraphers and students of distribution. He holds (p. 111) that the occurrence of Devonian beds in his State is confirmed by a review of specimens from the Napier Range, submitted to Dr. Henry Woodward.

Mr. H. Y. L. Brown reported to the South Australian Government in 1910 on the country south and east of the Murray River. The observations of geologists have here shown the existence of old river channels in a rock-floor under marine Tertiary beds; the latter receive water inland at their junction with the older rocks, and provide important reservoirs, through which the fresh water percolates gradually to the sea. Bores in the desert region have been successful. Mr. W. Howchin, of the University of Adelaide, describes two very striking moraines of the Permo-Carboniferous Glacial epoch at Rosetta Head and King's Point, South Australia (Trans. Roy. Soc. South Australia, vol. xxiv., 1910). The great boulders of transported granite appear to weather out as if they were of modern origin, just as they do in South Africa, where denudation has attacked the Dwyka beds (Fig. 2).

The Geological Survey of New South Wales has issued a well-illustrated account of the Murrumbidgee River district, where a storage-reservoir is in progress (Records, 1909, price 7*s.* 6*d.*, with large coloured maps and sections). The author, Mr. L. F. Harper, keeps in view the geological history of the country, and is by no means content with mere description. Messrs. R. Etheridge and W. S. Dun furnish a monograph on Eurydesma in New South Wales (Mem. Geol. Surv. New South Wales, 1910, price 7*s.* 6*d.*). This large Permo-Carboniferous lamellibranch is known only from Australia and from the Indian Salt Range. The authors support Morris, to whom the generic name is due, and differ from Stoliczka, by placing Eurydesma near Avicula. They regard Aucella as its nearest fossil, and Meleagrina, the pearl oyster, as its nearest modern representative. Its stratigraphical and local restriction gives it special interest. Mr. A. R. McCulloch has illustrated the genus by appropriately bold and striking plates.

In Victoria, Prof. Skeats describes the gneisses and dacites of Dandenong, twenty-five miles from Melbourne (Quart. Journ. Geol. Soc. London, 1910, p. 450). The interest lies in the conclusion that the gneissic rocks result from dynamic action on dacites, the product being subsequently altered by contact with a mass of granodiorite. Mr. F. Chapman (Proc. Roy. Soc. Victoria, vol. xxii., 1909, p. 263) has investigated the Batesford Limestone, devoting particular attention to the foraminifera and the ostracods. New species are described, and the rock is regarded as of Middle Cainozoic age. Mr. Chapman, by his continuous and patient work, is carrying out ably for Australia the traditions of Prof. T. Rupert Jones. Mr. R. W. Armitage (*Victorian Naturalist*, vol. xxvii., 1910, p. 21) reviews known cases of the inclusion of plant-remains in lavas, and records the discovery of charred wood in Pliocene basalt near Melbourne. The basalt has intruded minutely into the shrinkage-cracks of the timber, "along the medullary rays and around the annual rings." Mr. Armitage has also guided the Field Naturalists' Club of Victoria to West Essendon (*ibid.*, p. 83), and gives an interesting account of Cainozoic sands converted by percolating waters into quartzite. In discussing the literature of similar cases, he would have been aided by a fuller reference to the modern quartzites formed in arid regions of South Africa.

The Geological Survey of Queensland is naturally concerned principally with mines. Mr. L. C. Ball describes the Starcke Goldfield (Publication No. 223), where the reefs are formed through the replacement of the slaty country-rock by quartz and a triclinic felspar, the alteration spreading inward from fissures due to earth-movement. The occurrence of secondary felspars in similar

FIG. 2.—Granite erratic resting on Permo-Carboniferous glacial till, Palæozoic moraine of King's Point, South Australia.

veins elsewhere is referred to (p. 14). Mr. Ball also reports on minerals, including tin, mercury, copper, and coal, in North Queensland (No. 222, 1910). The coals of Cooktown are believed to be of early Mesozoic age; but the author refers (p. 37) those of Mount Mulligan to the Palæozoic, on account of the presence of Glossopteris. Mr. Marks describes the coal-measures of Trias-Jura age in south-east Queensland (No. 225), but does not add anything to their palæontology. A large map has been issued 1910), showing the topography of the mineral fields and coal-fields in east central Queensland, on the scale of one inch to four miles.

The Bulletins of the New Zealand Geological Survey continue to maintain their exceptionally high position. Messrs. Bell and Clarke (No. 8, 1909) make us acquainted with the scenery of the Whangaroa district, in the far north of the long promontory of Auckland. The difficulties so often met with in the palæontology of New Zealand appear to crop up here, and, in view of the scarcity of fossils and the uncertainty of those discovered, it is found impossible to divide the Kaeo series into a Mesozoic and a Cainozoic portion, though both are believed to be present. Greensands and "claystones" are its most extensively developed rocks (p. 49). Igneous rocks of Palæozoic (?) to Cainozoic age occur, and are illustrated by thin sections. Mr. J. H. Adams (No. 9, 1910) describes the Whatatutu subdivision in Raukumara, which is also in the North Island. Here satisfactory fossils enable him to place the whole of his beds, the Whatatutu series, in the Upper Miocene, and to reject a previous grouping into Cretaceous and Lower Cainozoic (pp. 12 and 23). Mr. C. Fraser (No. 10) treats of the Thames Goldfield in Hauraki, Auckland, which has suffered from the usual periods of "boom" and consequent depression. The "sensational development," however, of one mine in 1904 shows how irregular vein-mining may prove to be. One of the features of the district is the Table Mountain, formed by the weathering out of a huge dyke of andesite, which penetrated a plateau of easily eroded rhyolite-tuffs. The gold and silver ores began to be imported into the district in early Cainozoic times, and the vein-material partly fills fissures and partly replaces country-rock (p. 41). The "bonanza" deposits are attributed to waters that had acquired different characters meeting at certain points along intersecting veins, and thus promoting deposition. Mr. E. Webb (No. 11) writes on the country in the north of the Westport Division in Nelson. The faults which lowered the highland that once lay to the west of the New Zealand Alps play a great part in the physiography of this region, and the block-system of mountain-building is shown in the retention of fault-scarps between the highland levels and the lower land stretching to the coastal plain. Copper-ores and molybdenite have directed attention to the district.

G. A. J. C.

THE PHARMACEUTICAL SOCIETY'S SEVENTIETH ANNIVERSARY.

THE seventieth anniversary of the Pharmaceutical Society of Great Britain, which occurs this month, is an event of some considerable interest, which is not wholly confined to those who practise the art of pharmacy. Since its earliest days the society has devoted its attention to improvements in scientific education, and, indeed, before it was a year old, it had instituted courses of lectures in chemistry, materia medica, pharmacy, and botany. Its foundation dates from April 15, 1841, when at a meeting of chemists and druggists held at the Crown and Anchor Tavern, in the Strand, it was resolved to form an association "for the purpose of protecting the permanent interests and increasing the respectability of chemists and druggists."

At that time there were many men who by their training were well equipped for the work of compounding drugs and dispensing medicines, but owing to their lack of cohesion the science of pharmacy was making very slow progress. The rapid advances which the society made in the commencing years of its existence was in a large measure due to the pervading influence of its first president, William Allen, F.R.S., who, in addition to carrying on the business of a chemist in Plough Court, in the City, was a man with very considerable scientific attainments. In 1796 he had with several other young men formed the Askesian Society for practical scientific research, and three years later he helped to form the British Mineralogical Society, while in 1804 he delivered a course of lectures on natural philosophy at the Royal Institution.

With such a man at the head, there is little wonder that the newly formed Pharmaceutical Society became imbued with his scientific spirit, and turned to education as a means of raising pharmacy from the low level at which it stood as a calling in those days. The Royal Charter of Incorporation was obtained in 1843; therein the purpose of the society is set forth as being for the advancement of chemistry and pharmacy and the promotion of a uniform system of education of those who carry on the business of chemists and druggists. As already stated, the School of Pharmacy was soon established, and in 1845 a laboratory was constructed which compared favourably with the laboratories of Germany, including that of Giessen, and most of those in France. Having instituted a sound system of education and examination, the society was in a position to ask the Government for privileges for its members, but it was not until 1852 that an Act was passed restricting the use of the title of pharmaceutical chemist to examined persons. This Act did not restrict the sale of poisons, and the society had to wait another sixteen years before it obtained from Parliament a measure of legislation by which the retail traffic in poisons was placed in the hands of those who had passed the statutory examinations.

To revert to an earlier period and the efforts made to encourage scientific research, a committee was appointed in 1844, on the recommendation of Dr. Pereira, to investigate the then known materia medica. The committee was composed of several officers and members of the society, together with the professors at the school, and did a considerable amount of useful work, the results of which were communicated to meetings of the society. The evening meetings, held once a month in the autumn and winter, have contributed very largely to the advancement of scientific pharmacy, and the great improvements in the methods of preparation and administration of medicinal compounds which have been effected during the last seventy years have been due in a great measure to the discussions at these meetings.

The influence of the Pharmaceutical Society and its members on the British Pharmacopœia has been extremely important, notwithstanding that the society, as such, has no statutory acknowledgment of its work in this connection. In a paper read in 1845, Peter Squire, who subsequently held the office of president, pointed out the evils likely to result from the discrepancies existing in the formulæ of the Pharmacopœias for England, Scotland, and Ireland, but it was not until 1864 that the first British Pharmacopœia was published. When the preparation of this volume was contemplated, the council of the Pharmaceutical Society, at the request of the College of Physicians, appointed a committee to assist in its compilation, and when a few years later the duty of preparing the Pharmacopœia was transferred to the General Medical Council, the society was requested to keep in touch with that body. In the preparation of subsequent editions the services of pharmacists have been invaluable.

The British Pharmaceutical Conference, although in no way part of the society, largely consists of members of the society, and the parent body has never ceased to encourage the conference in the useful work it has accomplished. *The Pharmaceutical Journal* was founded in 184[illegible] by Jacob Bell, and has been the means of recording and distributing the results of work done in connection with pharmacy and allied sciences. The British Pharmaceutical Codex is another of the society's publications which has contributed to the progress of pharmacy. More recently the society has directed its attention to improving its educational system, which seems to justify the belief that the scientific spirit which imbued its founders has been inherited by those who govern its affairs to-day.

AMERICAN HYDROLOGY.[1]

THE investigations of the hydrographical department of the United States Geological Survey have already received notice in these columns, and of the reports under consideration, two belong to a group which has been described at some length. These are papers Nos. 262 and 264, dealing with the conditions of stream and river flow on the South Atlantic coast and the eastern Gulf of

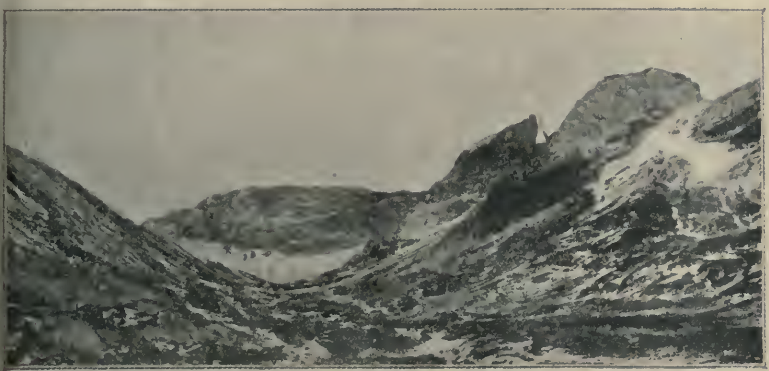


FIG. 1.—Synclinal Valley of Upper Willow Creek, Colorado.

Mexico (M. R. Hall and R. H. Bolster), and on the St. Lawrence basin (C. C. Covert, A. H. Horton, and R. H. Bolster).

The other five reports are of more distinctive character, and call for individual notice.

Paper No. 260 is a preliminary report on the ground waters of the Estancia Valley, New Mexico (Oscar E. Meinger). It is an investigation of the conditions affecting the irrigation of a valley in the centre of New Mexico, which is a depression 2000 square miles in area, without any drainage outlet. Insufficient rainfalls have been the cause of several crop failures. The proposal is to utilise wells for the supply of water, and, except perhaps in the central portion, where the presence of alkali threatens to impair seriously their quality, the prospect, on the whole, is favourable to a development of these subterranean supplies.

Paper No. 240 deals with the geology and water resources of the San Luis Valley, Colorado (C. E. Siebenthal). This valley lies in the south central part of the State of California, and has a length from north to south of 150 miles, and a maximum breadth of 50 miles. The area is drained by the Rio Grande, with a number of tributary streams, notably the Conejos River and La Jara, Alamosa, and Saguache Creeks. The geology of the district is summed up as a "Miocene deposition, unconformable below, of a series of sands, gravels, and interbedded lavas and tuffs, followed by orographic movements and additional volcanic activity, succeeded by quiet deposition of sands and clays in fresh-water lakes, passing without stratigraphic break into Pleistocene and Recent deposits." As regards its water resources, the San Luis Valley is an "almost ideal example of the artesian basin." Water occurs in beds of fine blue to grey sand, varying from 1 to 20 feet or more in thickness, separated from one another by beds of blue clay ranging from a foot to several hundred feet in thickness. The source of supply is the mountain streams which flow down from the higher levels and disappear as soon as they reach the alluvial slope. The Rio Grande itself in one section of 15 miles loses no fewer than 75 cubic feet per second by seepage. The report records the existence, by actual count, of 3234 wells capable of irrigating from 20,000 to 25,000 acres.

Paper No. 254 is of a similar character, treating of the underground waters of north central Indiana (S. R. Capps and R. B. Dole). The area covered is one of 7611 square miles, comprising nineteen counties. About two-thirds of it is covered with drift to a depth of more than 100 feet. This drift furnishes the water to by far the greater number of wells within its region, and there are few places where sufficient water for domestic needs cannot be obtained at moderate depths. For public supplies and manufacturing purposes, however, the source is inadequate. The report gives detailed particulars relating to the wells of the different localities, together with a comprehensive survey of the geological conditions. There is also included a section on the chemical character of the water and the means to be adopted to render it suitable for domestic and industrial uses.

Paper No. 253 is on the water powers of the Cascade Range; part i., southern Washington (Jno. C. Stevens). The Cascade Range runs through the States of Washington and Oregon with a general summit elevation of 6000 to 8000 feet. The higher peaks include Mount Shasta (14,380 feet), Mount Ranier (14,363 feet), and five or six others above 10,000 feet. The range is characterised by steep slopes and its streams by rapid flow. Add to this that there is an abundant and fairly uniform supply of water, fed during the summer by the snow banks and glaciers of the upper regions, and it will be seen that the district presents many interesting features from a hydrographical point of view, and is a very favourable locality for the development of water power. The area dealt with in the report comprises the drainage basins of the Klickitat, White Salmon, Little White Salmon, Lewis, and South Rivers flowing through the southern portion of the district and situated in Washington. Of these streams, the Klickitat is the most important, having a range of elevation of 3255 feet through the course of 73 miles surveyed, and being capable of developing some 150,000 horse-power under conditions of average minimum discharge. Altogether the potential horse-power of the district aggregates some 425,000.

The last report to be noticed is that, perhaps, which presents most features of interest to the general reader, as apart from the specialist. The paper on underground

FIG. 2.—Artesian Well on the Navin Ranch, San Luis Valley, Colorado.

waters for farm use (Myron L. Fuller) is a particularly valuable little manual affording a considerable fund of information within small compass on matters of vital importance to the community at large, and especially to the pioneer agriculturist—information which is very often regrettably outside the range of his ken. To commence with, there is a brief, general, and lucid account of the manner in which water occurs in the various geological strata, illustrated by some excellent photographs, with a statement of the relative safety of the different materials. The common sources of water supply are then discussed,

[1] Surface Water Supply of the United States, Papers 240, 253, 254, 255 260, 262 and 264. (Washington: Government Printing Office, 1910).

including lakes and ponds, streams, springs, wells, and cisterns, and the opinion is expressed that, of all these sources of supply, ground water is the most satisfactory for farm use, because it is least liable to pollution, and that streams and ponds are least trustworthy, because of the ease and frequency with which they are contaminated. Next follows a general description of underground waters and of the means to be adopted for their protection. The information on the subject of wells is detailed and complete, and includes some useful statistics of the cost of the various types, and a tabular statement of their advantages and disadvantages. The "safety distance" from possible sources of pollution is discussed, and that recommended ranges from 100 feet in clay and shale to 200 feet and more in sand and gravel. Boring tools and appliances and the methods of sinking wells are illustrated by diagrams and photographs. Altogether, the manual is one to be cordially commended for careful perusal and study by those dependent for water supply on local and adventitious sources.

It is interesting to note the author's remarks on the use of the "divining rod" for detecting the presence of underground water. He is of opinion that the alleged automatic deflection of the rod can only be attributable to unconscious muscular action, and that, however honestly the operator may believe in the reality of his powers, the irregularity of the results obtained and the numerous instances of failure recorded indicate that the system is crude, merely experimental, and quite untrustworthy.

B. C.

SCHOOL MEDICAL SERVICE.[1]

Only to those familiar with the origins of the medical inspection movement is it credible that, in little more than four years, a system should have developed that needs a Blue-book of upwards of 200 pages even for a brief summary of the work. The second report of Sir George Newman, chief medical officer to the Board of Education, shows that the system of medical inspection is now a fully organised service, producing its multitudes of new facts and propounding innumerable problems of detail.

Section I. deals with administration. The statement of policy is unambiguous. "From the outset the Board took the view that the Medical Inspection of School Children was but one of a number of activities comprised in School Hygiene, and the science and art of School Hygiene itself could not be regarded as an independent science and art which could be pursued in detachment from other studies, but was, in fact, an integral and vital part of that science which, under the name of Public Health, deals with all questions affecting the health and physical condition of the nation" (p. 3). Time alone can fully justify this statement; but, from the beginning, it appealed to the administrative mind. The creation of rival services for inseparable departments of health would have meant that one service would ultimately be superseded. The return of the public health officers into touch with the individual children has undoubtedly restored to that service a unity of purpose that it should never have lost. Preventive medicine includes personal as well as environmental hygiene.

This report contains much material to justify the Board's policy. Of the schedule used, it is important to record that "it is not, and never was, intended to be merely a means of collecting statistics. . . . The intention of Parliament was clearly that Medical Inspection should be of a practical character, and have practical rather than academic results" (p. 8). This is a timely warning against the danger of statistics heaped up without any synthetic idea. Nothing more disconcerts the man of practice, who, in this question, is more important as yet than the man of theory. On the whole, this year's reports come well out of the test. The medical men engaged in the medical school service number approximately 986; there are 73 women doctors and 289 nurses.

Section II. deals with the physical condition of the children as revealed by medical inspection. There are many interesting percentages as to cleanliness. Pediculosis is all too common, but the systematic schemes of cleansing have effected immense improvements. Incidentally, such schemes will help in the control of less easily perceptible parasites. There is abundant evidence that lavatory accommodation and spray baths are on the increase. But it is certainly disappointing to have to read that here 26 per cent., there 15 per cent., elsewhere 21 per cent., should suffer from vermin. It is, on the other hand, gratifying to find that, in one case, the 26 per cent. of one examination fell to 9 per cent. on the second examination, and this over a total of more than 3000 children. Obviously the activity of the parents has been stimulated by the concentration of attention on the parasitic state. Ring-worm is extremely common. This troublesome and wearisome ailment ought to be extinguished, but its extinction will be difficult. In some counties the cases amount to 1 in 73, in others to 1 in 45. In one town the cases were 1 in 67, in another 1 in 1000. Adenoids and enlarged tonsils and glands have contributed largely to the recorded ailments. So have defective hearing and defective vision. It is impossible to summarise the masses of facts and methods here detailed, but the special attention directed to the respiratory passages may be expected, in the long run, to reduce malnutrition and early tuberculosis. Heart disease should also profit by the inspection. One school medical officer reports "1·7 per cent. of heart disease among all children examined at five and thirteen years," but he adds that "three times as many suffer from hypertrophy or dilatation" (p. 61). Another found 2·3 per cent. among five-year-old children and 1·2 per cent. among twelve-year-old children. The association of heart disease with rheumatism has been carefully studied by some medical officers. Factors in the production of "dilated heart are anæmia, over-strain, work out of school hours, and cigarette smoking" (p. 62). Of seventy-six boys examined for "heart strain due to double digging undertaken in connection with the garden classes," nine showed signs of rheumatic heart disease, and "in eighteen other cases signs of heart strain were discovered" (p. 61). These facts are of fundamental importance in physical education. The whole question of the "rheumatism of children and adolescents" demands careful investigation.

The section on tuberculosis contains many facts of great importance. "It is interesting to observe that the percentage of tuberculosis among the routine cases is found to be 0·75 in 1909 as against 1·02 in 1908, and among the routine and special cases 1·22 in 1909 as against 1·31 in 1908. Among the special cases, the percentage shows a slight rise—2·02 in 1909 as compared with 1·97 in 1908" (p. 63). These figures refer to 683,715 children examined in 1909, as compared with 245,000 in 1908. It is not indicated whether any special reaction methods have been used in diagnosis. The amount of tuberculosis discovered in different localities varies enormously; but the results, if based simply on ordinary clinical inspection, cannot be accepted as indicating the full extent of tubercular prevalence. "The prevalence of phthisis among school children is still a matter upon which great differences exist among school medical officers, and this will continue to be the case until definite standards of diagnosis are introduced" (p. 66). The results recorded abroad from von Pirquet's reaction are in entire discord with the facts recorded here. It is obvious that the whole question of the prevalence of tuberculosis needs investigation *de novo*. It is a question of primary importance, not merely for practice, but for correct inferences as to heredity. If, as one observer (Dr. Herford, of Altona) finds, that, in an examination of 2594 school children, "63 per cent. reacted, 50 per cent. of the five-year-old groups, and 94 per cent. of those about to leave school" (p. 66), and if these results be verified, we must suspend judgment on the whole question of prevalence. If those results are correct masses of statements about "tubercular diathesis" and "intensity of inheritance" fall to the ground. The increase of open-air schools is a gratifying practical result.

Section III., on "following up," contains a good deal of important practice. Section IV. indicates the range of "medical treatment," including the improvement of school arrangements, sanitation, physical exercises, open-air classes, powers under special Acts for blind, deaf, defec

[1] Annual Report for 1909 of the Chief Medical Officer of the Board of Education Pp. 213. (London: H.M. Stationery Office, 1910.) Price 11*d*.

tive, epileptic, cooperation with the sanitary authorities as to infectious disease, directions to the parents, school nursing, contributions to hospitals, and establishment of school clinics (p. 94).

Section V. deals with dental disease and dental treatment. Section VI. discusses the problem of special schools for physically defective and epileptic children. Section VII. deals with feeble-minded children; Section VIII. with physical training. There are important appendices on practical questions.

Altogether, the Board of Education and its chief medical officer are to be congratulated on this conspectus of the school medical service, which is rapidly becoming the most important medical service in the country.

OPTICALLY ACTIVE PHOSPHORUS-COMPOUNDS.

ONE of the most fascinating problems of organic chemistry consists in the attempt to prepare compounds the molecules of which are devoid of planes of symmetry, and are therefore capable (like a screw or a glove) of existing in two forms, usually distinguished as left-handed and right-handed; these have the property of rotating the plane of polarisation of a beam of light to equal extents in opposite directions. Such compounds usually contain an "asymmetric" atom linked to four or five radicles all differing from one another; but compounds have recently been prepared in which the asymmetry cannot be attributed to any single atom, but is a property of the whole molecule (see NATURE, vol. lxxxii., p. 266, December, 1909; this vol., p. 93, March 16). In addition to carbon (linked to four different radicles), asymmetry has been traced by Pope and his colleagues to atoms of pentavalent nitrogen and of tetravalent tin, sulphur, and selenium, whilst Kipping has added tetravalent silicon to the list. The latest addition, that of pentavalent phosphorus, forms the subject of a recent paper by Prof. Meisenheimer in the Berlin *Berichte.* Two or three years ago this author described a new type of isomerism in the case of nitrogen, the chief characteristic of which was the presence of only four different radicles attached to the pentavalent atom instead of the five that had usually been thought necessary to give rise to optical activity. The conclusions then arrived at have been confirmed by the recent preparation of methylethylaniline oxide,

$$\left.\begin{array}{l}CH_3\\C_2H_5\\C_6H_5\end{array}\right\rangle N=O$$

in pure crystals, which displayed a large optical activity when dissolved in dry benzene, both the dextro and the lævo forms of the oxide having been separated and examined. The new phosphorus compound is of precisely similar composition, having the formula

$$\left.\begin{array}{l}CH_3\\C_2H_5\\C_6H_5\end{array}\right\rangle P=O$$

It was prepared by combining diphenylethylphosphine, $(C_6H_5)_2P(C_2H_5)$, with methyl iodide, liberating the base by means of silver oxide, and decomposing it by boiling with water, as indicated by the equation

$$(C_6H_5)_2(C_2H_5)(CH_3)POH = C_6H_6 + (C_6H_5)(C_2H_5)(CH_3)PO.$$

The inactive base was resolved by combining it with bromocamphorsulphonic acid—the same agent that was employed twelve years ago by Pope and Peachey in preparing the first active derivatives of asymmetric nitrogen—and was separated again from this acid by passing ammonia gas into a solution of the salt in benzene. The ammonium salt was filtered off, and the base separated in needle-shaped crystals of undoubted purity. When redissolved in benzene, the base showed the highly satisfactory rotatory power $[\alpha]_D + 33 \cdot 8°$ $[M]_D + 57°$.

The experiments now described provide a completed solution of a problem which had already been solved partially by Kipping and Luff (Proc. Chem. Soc., 1909, p. 203). These authors succeeded in isolating two isomeric hydrindamides of the formula

$$O=P\left\langle\begin{array}{l}OC_6H_5\\OC_7H_7\\NH\cdot C_9H_9\end{array}\right.$$

which differed from one another in optical rotatory power, and almost certainly contained the dextro- and lævo-rotatory forms of the phosphoric radicle; unfortunately, it was not found possible to separate this radicle from the active hydrindamine which had been used in resolving it, and the final proof of the activity of the phosphoric radicle could not be given.

METEOROLOGICAL REPORTS AND SUMMARIES.

MANILA WEATHER BUREAU (1906).—The meteorological observations at the secondary stations have now been published, and form part ii. of the annual report (part i., referring to the central observatory, appeared some time ago). It extends to 404 quarto pages, and includes daily observations and monthly means at the stations which at that time constituted the meteorological service of the Philippines. The observations are carefully collated and examined at the central observatory; some of the stations extend to the Ladrone and Western Caroline Islands, and are of the utmost importance in connection with the origin and premonition of the destructive typhoons that frequently advance from that part of the Pacific Ocean. They are also used in the preparation of the valuable monthly weather bulletins of the bureau, to which we have often had occasion to refer.

Toronto Observatory (1908).—During the year covered by this report, the building used since 1855 was replaced by a new Canadian Meteorological Office and Observatory. The following values are taken from the useful summary of results given for each month and the year, with differences from the average of the past sixty-nine years. The extremes of temperature are taken from the maximum and minimum thermometers in the Stevenson screen. Highest temperature (July 30), 91·5°; lowest (February 4), −17·4°; highest on record, 99·2°; lowest, −26·5°. Mean of highest readings in 1908, 55·8°; of lowest, 37·7°. Mean from max. and min., 46·7°, being 2·7° above the average. Highest solar radiation (August 4), 128·3°; lowest night radiation (February 4), −21·0°. Rainfall, 21·72 inches; depth of snowfall, 77·8 inches. Percentage of possible sunshine, 47, the average for the past twenty-seven years being 42 per cent. The mean W. declination was 5° 54·1′; dip, 74° 36·9′.

Korea Meteorological Observations (1908–9).—These valuable observations and results are in continuation of those referred to in our issue of May 19 last. The following statistics refer to Chemulpo Observatory (lat. 37° 29′ N., long. 126° 32′ E.) for 1909. Temperature:—mean maximum, 58·5°; absolute, 93·2° (in August); mean minimum, 44·1°; absolute, 8·1° (in December); annual mean, 50·7° (normal, 51·1°); rainfall, 25 inches (normal, 37·7 inches), days, 96; sunshine, 2746 hours (62 per cent. of possible amount). The instruments and methods are the same as those at Japanese stations.

Odessa Observatory (1909).—We are glad to see that Prof. Stankevitsch proposes to cooperate regularly in the international researches of the upper air. Two kite ascents were made in December, but only moderate altitudes were reached. At present this important work can only be carried out under difficulties, as the director and his principal observers are engaged at the University. The annual summary shows that the mean temperature was 50·7°; January, 21·2°; July, 74·3°; absolute maximum, 94·8° (in July), minimum, −7·2° (in January). Rainfall, 14½ inches, on 98 days; fog, 58 days; frost, 95 days. Appendices give the normal values for a number of years (see NATURE, February 16), also rainfall and thunderstorms, at stations in south-west Russia.

India Weather Review, Annual Summary (1909).—The greater part of this work is taken up by the calculation of the monthly and annual departures of each element from the normal values, and a useful discussion of the results under four seasons: cold-weather period (January and February), hot-weather period (March–May), south-west monsoon period (June–September), period of the retreating south-west monsoon (October–December). These are followed by abstracts of the observations made in India and a few extra stations, and by maps relating to rainfall, and the tracks of cyclonic storms formed in the

Indian seas. The temperature in 1909, as in the two preceding years, was slightly colder than usual. The lowness occurred almost entirely in northern and central India, owing chiefly to a defect of day temperature; the largest deficiency occurred in April and June. The total rainfall, on the average of the whole of the plains, was 2·1 inches (5 per cent.) above the normal, which is the largest excess since 1894. In the Indian Ocean it was very irregularly distributed, being 25 per cent. below the normal at Seychelles, nearly normal at Mauritius, and 43 per cent. above the average at Zanzibar.

Deutsche Seewarte, Hamburg (1909–10).—The observations and results for stations under the control of the Seewarte are published in its *Jahrbuch* for 1909 in the usual form (Nature, May 19, 1910). The present volume, the thirty-second of this valuable series, includes ten stations of the second order (for four of which hourly readings are also given) and extracts relating to storms from registers kept at fifty-seven signal stations. The following values are quoted from the annual summary for Hamburg:—temperature: mean maximum, 52·2°; mean minimum, 41·4°; mean, 46·4°; absolute maximum, 81·7° (May); minimum, 9·3° (January and February); rainfall, 27·8 inches, 164 days. Fog, 64 days; the only months free from it were April–June.

Like its predecessors, the thirty-third annual report of the work of the Deutsche Seewarte, for 1910, contains full details of the staff, observers, and of the duties performed in various departments. In the branch of ocean meteorology, one is struck by the increasing number of observers, now numbering about 1075, and at the amount of data relating to the sea, about 4228 months' observations during the year in question. This branch is actively promoted by agencies at twenty-three ports, which, in addition to other duties, undertake the verification of instruments. The observations are utilised in monthly meteorological charts and daily synoptic weather charts of the North Atlantic Ocean, and many other useful publications. The department dealing with weather telegraphy and storm warnings also shows great activity. An exchange of telegraphic observations is kept up with foreign services, and is supplemented by daily kite observations and reports from mountain stations. We have before mentioned the useful experiments of issuing storm warnings to the North Sea and Baltic deep-sea fisheries, &c., by wireless telegraphy. Several other departments are engaged in valuable work, including the issue of handbooks and other publications, to some of which we have frequently had occasion to refer.

Stonyhurst College Observatory (1910).—The results of the meteorological observations show that the mean temperature of the year, 47·2°, was 0·4° in excess of the average. The warmest month was August, 57·2°, and the coldest January, 37·0°; June had the greatest number of high readings: above 70° on nine days. The absolute maximum was 78·0°, in June and July; minimum, 13·5°, in January. The annual rainfall was 53·29 inches, being 6·26 inches above the normal. The amount of bright sunshine was only 28·3 per cent. of the possible quantity. Terrestrial magnetism forms an important part of the work of the observatory; the yearly mean values were:—declination, 17° 20′ W.; inclination, 68° 42·2′; horizontal force, 0·17407 C.G.S. units. Data relating to magnetic storms are supplied to the International Committee on Terrestrial Magnetism and to Potsdam Observatory. The solar surface was observed on 166 days; on 40 days the surface was found quite free from spots. The principal meteorological means, &c., are compared with the averages of 63 years; this long period greatly enhances the value of the data.

MUSEUM CONFERENCE AT HALIFAX.

A CONFERENCE of members of the Museums Association and other persons interested in museum work was held at Halifax on April 8. Halifax is peculiar in the organisation of its two public museums, which are directed by honorary curators, under the control of the Education Committee of the borough, and it was by these authorities that the conference was summoned. About sixty persons attended, including representatives from Liverpool, Manchester, Sheffield, Salford, Hull, Bolton, Warrington, and other museums in Lancashire and Yorkshire. After the Natural History Museum (Belle Vue) and the Museum of Anthropology and Arts (Bankfield) had been inspected, and tea taken on the invitation of the Mayor of Halifax, the chair was taken by Mr. Howard Clay, chairman of the Education Committee.

Mr. W. B. Crump, Halifax Museums, read a paper "On a New Method of illustrating British Vegetation in Museums," in which he described the exhibition of common British trees at the Halifax (Belle Vue) Museum, where it is carried out from the nature-study point of view, so as to direct attention to the features in the life-history which are readily observable in the woods, and proceeded to advocate the arrangement of botanical specimens in popular museums on a geographical basis instead of the usual systematic plan. A Pennine moor, an oak wood, a salt-marsh, the vegetation of a pond, may, by careful selection of material and the free use of photographs, be effectively illustrated in a museum.

Mr. H. Ling Roth, Halifax Museums, in a paper "On the Use and Display of Anthropological Collections in Museums," compared the two methods, the geographical or ethnographical and the Pitt-Rivers or topical method, in which latter the evolution of articles for some definite use is exhibited. By the study of unrisen peoples we may learn a great deal about our own gradual progress. Specimens should be accompanied by illustrations of the people who make and use them, and collections should be formed to show how things are made. All the points were demonstrated by reference to the exhibits in the Bankfield Museum. Mr. T. Sheppard, Hull Museum, spoke of the advantages following the publication of guides to the museum, and gave particulars of ways and means. Mr. H. P. Kendall made an appeal for the more systematic collection in museums of prints and other illustrations of local antiquarian interest.

SOME RECENT FISH LITERATURE.

TO the Philippine Journal of Science for October, 1910, Mr. Alvert Seale contributes an account of a collection of Bornean fishes; this includes 117 species, of which ninety-one are common to the Philippines. Among the five species described as new, mention may be made of a shark, *Carcharias borneensis*, allied to *C. dussumieri*, but differing in the position of the fins and the form of the teeth.

The Japanese representatives of the families Sciænidæ, Lobotidæ, and Lutianidæ form the subject of two papers by Messrs. D. S. Jordan and W. F. Thompson in the Proceedings of the U.S. National Museum, Nos. 1787 and 1792. Of the first family Japan possesses few species, all referable to the typical subfamily, and allied to Chinese and Indian types; there is but one representative of the second family, and the species of the third are not numerous, although two are sufficiently common to be of commercial value. It may be noted that in the second paper a new generic name is proposed for a Hawaiian fish. In No. 1782 of the same publication Mr. T. Gill discusses the structure, affinity, and habits of the wolf-fishes. From peculiarities in the structure of the scapular arch and the actinosts of the fins, coupled with the absence of ventral fins, the author supports the views that these fishes should be separated from the Blenniidæ to form a family by themselves—the Anarrhichadidæ. Examination of the skeleton demonstrates that the current classification of the genera requires radical amendment.

The generic and, in some degree, the specific name of the typical wolf-fish (*Anarrhichas lupus*) is based on a misconception, the former term signifying a climber, from a legend that these fishes occasionally leave the water and clamber on to the rocks, while the latter seems to have been given from an idea that they prey on other fishes. It has, however, long been known that they feed almost exclusively on molluscs, crabs, and sea-urchins, for seizing and crushing which their powerful dentition is specially adapted. Most of the species are normally inhabitants of depths where perpetual darkness reigns; and when the typical wolf-fish visits shallow water for spawning, it is active only at night. In spite of the prejudice against the wolf-fish on account of its hideous head and formidable teeth, the flesh is stated to be excellent for the table.

To the Proceedings of the Academy of Sciences of Philadelphia for October, 1910, Dr. H. W. Fowler contributes notes on little-known New Jersey fishes, and likewise notes on various chimæroids and ganoids. In the latter a new chimæra is described from New Zealand, and two new species of Cylindrosteus are likewise named.

In the same serial for December, 1910, Mr. Burnett Smith describes certain fish-remains from the Devonian of New York. Most of these are species pertaining to the European genus, Machæracanthus; but the author was fortunate enough to obtain part of the armour of a small arthrodire, which is provisionally regarded as referable to the plastron of a species of Dinichthys. Assuming this to be the case, he points out that the generally received determination of the bony elements of this part of the exoskeleton is incorrect.

In *Science Progress* for January, Dr. H. H. Swinnerton gives reasons to show that the ordinary view as to the respective functions of the median and paired fins of fishes require revision. These views are based, at any rate to a considerable extent, on the movements of fishes which have been deprived of one or more of their fins; but the author points out that operations of such severity must have caused very serious shock to the patients, and thus induced "wobbling" and other eccentric movements. As regards the hind dorsal and the ventral fin, the author is of opinion that their function is connected with the tail-fin, which is the sole propelling organ of the fish. The anterior dorsal fin, on the other hand, appears to serve as the chief agent in the rapid turning movements which are essential to the safety of a fish living in swiftly flowing waters. As regards the functions of the paired fins, these appear to have changed *pari passu* with the modification in the structure and orientation of these appendages which has taken place as we pass from ancient generalised to modern specialised types. To follow the author in tracing these out would, however, occupy too much space on the present occasion, and it must suffice to state that whereas in the primitive fossil shark Cladoselache the paired fins were little more than broad-based lobes on the sides of the body, with their expanded surfaces in the plane of the latter, in modern teleost fishes they are narrow-based fan-like structures, with their broad surfaces capable of being extended at right angles to the axis of the body. And the author has found that "it is possible to recognise a complete sequence from the broad-based fin acting as a keel, through the narrow-based fin with limited freedom acting as a lateral rudder, to the narrow-based fin with great freedom of movement which enables it to be used either as a keel, a lateral rudder, or a break."

In the April number of *The Zoologist* Colonel C. E. Shepherd continues his account of the pharyngeal teeth of fishes, dealing in this instance with the members of the cod family (Gadidæ) and the Carangidæ. R. L.

TECHNICAL TRAINING AND THE OPTICAL INDUSTRY.

THE scheme for the establishment of an Institute of Technical Optics in London was described in a short article in the issue of NATURE for March 16. In that article reference was made to two elaborate reports, covering nearly forty pages of foolscap print, and signed, respectively, by the education officer of the London County Council, Mr. R. Blair, and the Council's educational adviser, Dr. Garnett. The contents of Mr. Blair's report provide much information as to the provision made in this and other countries for higher work in technical optics, and we here reprint extracts from this report as showing the need for the action of the London County Council.

Introduction.—Although the United Kingdom is no longer in the forefront of the optical industry, the science of optics stood on a high level in this country for about 140 years after the publication of Newton's "Treatise on Optics" in 1704. Since 1850, however, the study of geometrical optics has progressed rapidly in Germany, but has been practically at a standstill in England. The trade conditions in both countries have kept pace with the state of optical knowledge. At one time the United Kingdom made most of the best optical instruments in the world and produced a large proportion of optical inventions. But latterly, inventions, presumably owing to more improved facilities for study and practical training, have been more numerous in Germany than in the United Kingdom. The great increase in the German production and export has also been assisted by many other factors, amongst which may be mentioned the help afforded by the Imperial Physical-Technical Institute at Charlottenburg (which should not be confused with the Technical University at the same town), the efforts of the Association of Instrument Makers, and the perfection to which the production of the special glass required has been brought at Jena. During the last fifteen years it has been gradually recognised in England that if the lost ground is to be regained, either wholly or partially, adequate provision must be made for optical instruction in all its branches.

A large amount of valuable information had been gradually gathered together, but, in view of the considerable expenditure suggested in aid of technical training for the optical industry, the presentation of this report was postponed until all available sources of information could be consulted. The inquiries include information regarding the extent of the trade in London and the provinces; the amount of capital invested and the number of workmen employed; the amount of imports and exports; any pecuniary support likely to be forthcoming from the trade or other sources, and the extent to which the trade would cooperate both in giving facilities to employees to attend the proposed institute, and in other ways; the question as to what branches of the optical industry should be included in the scheme, and the nature and extent of the institute as regards accommodation, equipment, and staff. It has also been necessary to study carefully the conditions of optical instruction and trade in Germany, and to investigate the statements and representations on behalf of their interests made by persons and bodies interested in the science of optics and the manufacture of optical instruments in England.

The final results of the investigations made and the conclusions which may reasonably be drawn from them, taken as a whole, point to the necessity for the establishment of the proposed institute for industrial, scientific, and national reasons—industrial because of the lack of progress in the British optical industry compared with the rapid progress made in Germany, and the fact that the value of an optical instrument lies almost wholly in the scientific knowledge and skilled labour applied to its making; scientific because of the necessity to the scientific worker of the production on the spot of the best and most suitable instruments for the purposes of pure and applied science; national because of the necessity of the home production of instruments for various branches of the public service.

COMPARISON BETWEEN THE PROVISION OF OPTICAL INSTRUCTION IN ENGLAND AND GERMANY.

It appears beyond doubt that instruction in pure and applied optics and in fine instrument making is much more developed in Germany than in England. At most German universities, especially the technical universities, the importance of optics and its practical applications are recognised to a greater extent than in England; in some cases attention is even devoted to the practice of instrument making. At English universities optics are either practically neglected or are taught as a branch of physics together with sound, heat, and electricity. When attention is devoted to optics, the practical application of optical principles to the designing of instruments is almost entirely disregarded.

With regard to special technical schools for instrument making, Germany possesses four, England only a department of an institute. Moreover, the German schools are generally housed in proper buildings and well equipped for theoretical and practical work, whilst the building and equipment of the Northampton Department of Optics are quite inadequate.

The attention devoted to the German schools is reflected in the attendance of full-time day pupils:—Schwenningen, for example, has seventy-two, Göttingen eighty-eight, of whom a large number are engaged in technical optics. The department at the Northampton Institute has twenty

students, most of whom are engaged in sight testing and spectacle making and not in optical instrument making. The liberal funds available for the German schools enable them to charge only about 30s. per annum for full-time instruction. The Northampton Institute is compelled to charge 15*l*. per annum, a fee which many students must find it impossible to pay.

It is of some importance to observe that the four German schools, as their names imply, are organised for the teaching of fine instrument making generally, whereas the Northampton department is principally concerned with optical instruments.

Finally, it may be noted that the German schools have been established by the municipalities concerned, generally as a result of action taken by the local trades. They receive, however, maintenance grants from the States concerned and appear to be in close touch with the authorities.

The single courses given in fine instrument making at various German trade schools are at least equal in organisation and quality to the one or two courses at technical colleges in England and are greater in number. The work of the Munich course has been developed to that of a department of technical optics; 201 pupils receive eight to nine hours' instruction per week.

The more numerous and superior opportunities for optical instruction in Germany have made themselves felt in all directions. Formerly a large number of optical inventions were made in England. Latterly, they have been more frequent in Germany, and the resulting trade has gone to that country. The records of the Patent Office are conclusive in this respect; such names as Zeiss, Goerz, Anschütz, Steinheil, Busch, &c., are household words in British optical circles. Some British firms are compelled to employ foreign mathematicians.

No practical text-book of optics exists in English, and the principal technical literature on the subject of optical progress and inventions is in German. The Northampton Institute is the sole place in England where the Gauss system of computing simple lenses and lens systems is properly taught. English optical instrument makers who wish to keep abreast of their science and industry are compelled to learn German and teach themselves.

In spite of these drawbacks, many important recent inventions have been made in England; in fact, as regards the quality, the English optical inventions are probably unrivalled, although in quantity they are less. As British enterprise and manual skill are not inferior to German, it is reasonable to suppose that this country would easily hold its own if the necessary opportunities for full instruction were provided. In former times optical problems were simpler and technical methods less complex. This has entirely changed, and to-day Germany, the country with the best optical literature and instruction, produces most inventions and has the biggest output and export.

In spite of the advances made in optical instruction in Germany, it does not appear that the optical trade is by any means content with what has been done. The instrument-making schools are being improved and expanded, and trade classes for instrument-making at other technical schools are being increased and developed. To give two recent examples—the Göttingen school has just moved into a new building, and the Munich course has been converted into an independent department. Technical optical lectures are increasing at technical and older universities. There is a strong feeling that much more could be done by the State and municipalities for the further advancement of technical optics. This is very significant in view of the fact that the British industry at present is pressing for only a part of the educational facilities already at the disposition of the German industry.

Comparison between the Extent of the British and German Optical Industries.—Germany, the country with the most numerous and best-equipped schools, departments, and courses for teaching instrument making, and with the best technical universities, has captured the largest amount of the world's optical trade. Starting well behind France and England, she has thoroughly beaten both countries in the amount of her production and export. In both countries there is considerable difficulty in obtaining trustworthy figures as to capital and the number of workmen employed. Fairly definite figures, however, can be obtained from the export and import results and the British census of production figures.

The net British exports of scientific instruments, &c., have only increased from 395,009*l*. in 1900 to 509,185*l*. in 1909. But at the same time there has been a heavy import, commencing at 595,305*l*. in 1900 and rising to 666,563*l*. in 1909.

The German export of scientific instruments, &c., was valued at 1,200,000*l*. in 1898, and for 1909 it was valued at 2,276,550*l*. Since 1904 alone it has increased by 776,550*l*. Imports into Germany appear to be very low, whilst in England the imports are so heavy as to be larger than the exports. At the present moment the German export of optical instruments is almost as great as the whole of the British production. Apparently the British trade has no true exports in the sense of excess of exports over imports, and is dependent upon foreign imports for a part of the home consumption. In spite of all these disadvantages, however, the British industry continues to exist and do excellent work. The Germans state that at the Brussels Exhibition, 1910, both the British and French industries were well represented, and they direct special attention to the large English catalogue with its good illustrations.

Germany and France appear to possess almost a monopoly in the production of the special glass required for optical instruments; the French glass is made from German formulæ. Large quantities of raw optical glass and of partially and fully finished glasses and lenses are annually exported to England. If this export were interfered with by any cause, a large section of the British industry might possibly find itself in a very grave position.

It is not technical education alone which has assisted the German industry. There has evidently been a keen demand for the finest instruments of precision made in the country itself on the part of men of science, professors, professional men, the army, the navy, and manufacturers. Great help has also been afforded by the following factors:—

German Association of Instrument Makers.—The association was founded in 1881. It looks after the interest of the trade in every respect with regard to general education, technical training, commercial education, international and other exhibitions, and finally by representations to the Imperial Government. This last point seems of some importance, and some details may therefore be given. It appears that, as far back as 1890, the association was agitating for the proper differentiation, in official documents, between optical and other fine instruments. The difficulties caused by the lack of a suitable scheme of classification have already been mentioned. At the same time the association was making representations against a protective tariff for instruments manufactured in Germany, as their second market lay in foreign countries, and reprisals were feared. Other negotiations have been carried on with the Government with regard to avoiding the duties paid on the re-import of instruments for purposes of repair. This is most significant, as it shows that instruments sold abroad cannot be repaired abroad, but have to be returned to Germany for this purpose. The association deals very fully with all questions regarding the participation of German firms in international exhibitions and with representations concerning the imposition of foreign tariffs on German goods. In one case it approached the Danish Government with reference to obtaining a larger amount of Iceland spar for optical purposes.

Jena and the Optical Industry.—Much of the success of the German industry comes from the town of Jena, where the firm of Zeiss is situated. Three men combined together in order to produce what was required for the optical industry. These were Dr. Schott, a glass manufacturer; Prof. Abbe, an oculist; and Carl Zeiss, a microscope maker. Prof. Abbe's efforts have had great influence upon the German industry. He introduced many improvements, and endeavoured not only to benefit his own firm but the whole industry. Dr. Schott obtained a grant from the Prussian Government for the purpose of investigating the best kinds of glass for optical purposes, especially with regard to the relation between the optical properties of glass and the chemical composition of solid amorphous fluxes. The result is that Schott has almost a world's monopoly for the best kind of special glass for optical purposes. Where one of the very few English glass manu-

facturers will quote at most about twenty-five different meltings, Schott of Jena, and Parra-Mantois of Paris will quote anything between 100 and 150. It may be mentioned that the University of Jena has benefited to the extent of about 100,000*l.* by the success of the firm of Zeiss. At the present time the firm of Zeiss employs about fourteen graduates who are either mathematicians or medical men.

Imperial Physical-Technical Institute.—Very great assistance has been rendered by the Imperial Physical-Technical Institute in Charlottenburg, which, as above mentioned, should not be confused with the Technical University in the same town. It was founded in 1887, and is concerned partly with physical research and partly with the development, standardising, and testing of fine instruments of almost every description. Its relations to the optical industry are numerous and intimate, and the manufacture of optical instruments has benefited accordingly.

The British Optical Society.—Some account may be given of the Optical Society on account of its relations to the optical department at the Northampton Institute and the trade generally.

The society was founded in 1899, and has over 400 members in London and the provinces at the present time. It has kept alive the interest of the different branches of the trade in the technical optics classes at the institute, and has for a series of years contributed about 110*l.* per annum towards the expenditure for the same.

It has also been instrumental in placing the trade in communication with the institute with regard to the details of optical work. In 1901 it appointed an educational committee for the purpose of inquiring into the question of optical education generally. In 1902 Prof. Silvanus Thompson read an important paper on "Technical Optics" before the Society of Arts, in which he strongly urged the establishment of a real optico-technical institute either at the Northampton Institute or elsewhere. The same conclusion was arrived at by the Education Committee of the Optical Society. The committee pointed out that it was only by the provision of such educational facilities that the optical trade of this country could be expected to compete with its foreign rivals, and that the Northampton Institute, with its teaching staff and equipment, would be the suitable place for the new optico-technical institute.

The German industry has received much more benefit from its association than the British industry from the corresponding association in England. Finally, as the German research and standardising institute at Charlottenburg came into existence long before the corresponding English institute, it has consequently been enabled to get into closer and more fruitful touch with the optical industry.

The Optical Convention in 1905.—The convention dealt not only with scientific and trade subjects, but devoted considerable attention to the problem of optical education. On this last point it adopted the following resolution:—

"That the Optical Convention hereby expresses the cordial approval of the project of founding an optical technical institute for the training of opticians in the scientific principles of optics and their technical applications which it regards as a matter of industrial importance to the nation; and in view of the backward state of optical teaching in this country it urges the London County Council to push forward, as a matter of pressing need, the foundation of such an institution on the lines of the scheme which was under the consideration of the late Technical Education Board."

THE PARAMOUNT IMPORTANCE OF THE OPTICAL INDUSTRY FOR INDUSTRIAL, SCIENTIFIC, AND NATIONAL PURPOSES.

It may be urged that the expenditure contemplated (amounting to 35,000*l.*, together with an annual maintenance grant rising eventually to 5000*l.*) is comparatively large in proportion to the extent of the optical industry, its capital, number of employees, and production. But this objection can scarcely be maintained when the problem is studied in all its far-reaching aspects.

In the first place, there are very few industries where the ultimate value of the goods produced represents so much in wages for the skilled designers and workmen and so little in the actual scrap-value of the materials employed. It is difficult to find an exact parallel in other branches of manufacture. For example, the production of valuable chemical products from certain raw materials as the result of intricate investigation and a long series of reactions. Or, perhaps the case of artistic products in which the actual value of the materials is very little compared with the value conferred by the insight of the artist and the cunning of his hand.

The overwhelming importance of the optical industry on the larger scientific and national issues involved was very clearly stated by Mr. Conrad Beck on the occasion of the deputation of the optical industry to the Technical Education Board in 1902. He pointed out that the number of instruments, for the manufacture of which optical knowledge is required, was very great indeed, ranging from ordinary spectacles, opera glasses, field glasses, telescopes, nautical instruments, microscopes, photographic lenses, photographic apparatus, and so forth, to surveying instruments, astronomical instruments, lanterns, range finders, gun sights, lighthouse prisms and reflectors, heliographs, periscopes, and almost every kind of optical instrument.

These instruments are widely used in the prosecution of science, in industrial processes, in the exercise of many important professions, in our shipping trade, the greatest in the world, and in the nation's naval and military lines of defence.

It cannot be too clearly understood that the success of the manufacture of all the instruments mentioned depends upon a thorough knowledge of practical optics on the part of designers and managers, and upon a constant supply of skilled foremen and workmen.

In times of peace the War Office and the Admiralty probably require something like 25,000 field glasses and telescopes per annum, and much larger number in times of war; the numbers sold to private individuals are, of course, much greater. Both the War Office and the Admiralty have been approached with regard to the influence which the proposed optical institute will have upon the production of the finest kinds of optical instruments used in the army and navy.

Spectacles, sooner or later, are worn by large numbers of persons. Field glasses and telescopes alone constitute a large business. All medical, biological, and many other students require microscopes; every ship's officer requires a sextant. Engineers require large numbers of levels and theodolites. The number of photographic lenses sold annually is extremely large. The illustrations of magazines, newspapers, and the majority of books are produced by photographic printing processes, largely depending for success on optical principles.

The advent of long range guns has been responsible for a special section of the optical industry concerned with the manufacture of elaborate optical gun sights and special telescopes of peculiar construction; new methods for range finding by optical instruments are being constantly sought.

In various industries a microscope is becoming each year of greater importance. It is used in the testing of steel and iron and for brewing, butter making, silk and textile manufacture, sugar making, and in numerous other industries. The photographic industry alone, which has assumed such great dimensions during recent years, is entirely dependent upon optical principles. Although large amounts of chemicals are used in photography and various materials for the construction of cameras, all the work employed would be entirely useless without the proper designing of the lenses employed.

Finally—although it cannot be definitely stated in concrete terms—there would appear to be some relation between the general efficiency of a nation and its manufacture of the finest instruments of precision for purposes of observation, research, measurement, and control. The material development of a nation is largely concerned with the utmost utilisation of the natural forces and materials at its disposal, and both pure and applied science are becoming increasingly dependent upon the help afforded by the finest instruments. A nation should have for this purpose an ample supply of the finest instruments. It should manufacture these itself for its own special purposes, and keep itself in a condition to repair and improve existing instruments and invent and construct new ones. It is significant to observe that both England and France have fallen behind Germany in this respect.

Final Remarks and Recommendations.

I have no hesitation in stating that a case has been made out for the establishment of the institute on broad and comprehensive lines, an institute which shall not only serve the needs of London, but also be of use to everyone connected with optical matters in the United Kingdom. The state of the industry, scientific opinion, and the other considerations involved, point to the need of the establishment of an institute without further delay. At the present moment an opportunity is afforded for utilising to the full the experience gained in foreign countries, the optical instruments of which have, to a large extent, supplanted our own. The Optical Institute, if founded, might become, under proper management, the first of its kind in the world. The material for doing this is at hand; it should be remembered that even in its present incomplete condition the optical department of the Northampton Institute has been visited by foreign technical experts, and many of its leading features copied.

The investigation has shown that the widest cooperation may reasonably be expected from eminent men of science, from the leading manufacturers, and from the University of London, other universities, and the Imperial College. The institute is thus assured of the best scientific advice possible and of actual practical help from interested manufacturers, and it will benefit by being linked up with institutions of university rank for the purposes of the finest research directly applicable to practical and industrial purposes.

The principal decision to be arrived at by the subcommittee at the present stage is whether capital expenditure, amounting to 35,000*l*., and an annual maintenance grant rising eventually to 5000*l*., for the benefit of the optical industry is justifiable, bearing in mind the great national and industrial issues involved. Most of the further details must be considered later and must form the subjects of special reports. Such details will include the proportion of instruction to be devoted to optical instruments in particular and to other fine instruments of precision, the final arrangement of the rooms, details of staffing, the nature of the equipment, the prosecution of research in optical instruments and in optical glass, and so forth. A sum of 5000*l*. in respect of the contemplated expenditure has been included in the capital estimates for 1911–12, and I recommend:—

(1) That a grant of 35,000*l*., including 5000*l*. for equipment, be allowed to the governors of the Northampton Polytechnic Institute (*Finsbury, C.*), in respect of an institute for technical optics as set forth in the foregoing report.

(2) That the institute be built upon the site already purchased by the governors of the Northampton Polytechnic Institute.

(3) That the institute be governed by the governing body of the Northampton Polytechnic Institute.

(4) That a consultative committee be formed for advisory purposes, on which the optical trade shall be adequately represented.

(5) That, for research and other purposes, steps be taken to affiliate the institute to the Imperial College of Science and Technology, and to associate it closely with the National Physical Laboratory at Teddington and institutions of university rank.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Announcement of generous bequests to Aberdeen University is made in *The Times*. From this source we learn that the late Miss Anne Hamilton Cruickshank, daughter of the late Prof. John Cruickshank, who held the chair of mathematics in Aberdeen University, has provided by her will for a professorship or lectureship in astronomy, including navigation and meteorology, in the University, and for a science library at Marischal College. Miss Cruickshank bequeaths 10,000*l*., from which the trustees are to apply such amounts as, with the funds already in their hands for the same purpose, will make up a total of 10,000*l*. for the institution and endowment of a lectureship or chair of astronomy, including navigation and meteorology. Any balance of the 10,000*l*., after deduction of the sum required for the institution of a chair of astronomy and the cost of the windows, is to be set aside and applied in such manner as the special trustees may think proper for the library at Marischal College. Miss Cruickshank also leaves 10,000*l*. to the special trustees for the founding and supporting in Marischal College of a science library, to be called the Cruickshank Science Library.

Lady Kelvin has made a gift of 500*l*. to the University of Glasgow for the purpose of founding therein a prize for original research in physics, in memory of the late Chancellor. The prize, which will be accompanied by a gold medal, will be awarded once in three years to a doctor of science who has graduated in the interval, and whose dissertation contains evidence of original experimental work deserving of this special distinction. A similar prize was recently founded by the pupils and friends of Prof. William Jack, to be awarded for the most distinguished mathematical thesis offered for the degree of D.Sc.

At a meeting of members and officials of local education committees, held at Aberystwyth on April 18 in connection with the Conference of the National Union of Teachers, a discussion upon the necessity for further financial aid for education from the central exchequer was opened by a paper read by Mr. G. S. Baxter, secretary of the Sheffield Education Committee. The following facts from Mr. Baxter's paper are of interest. For the year 1904–5, the expenditure of local education authorities on current account for all purposes pertaining to elementary education only was 18¼ millions, towards which Government grants of 9½ millions were received, whilst for the year 1908–9 (the latest available official returns) the expenditure of local authorities had increased to 23 millions and the Government grant to 11½ millions. Therefore, although local charges increased by 4¾ millions in four years, the State contribution only advanced by about 1½ millions. In addition to the added responsibilities in respect of elementary education, the cost of supplying and aiding secondary, technical, and higher education for the year ended March 31, 1909, amounted to 4½ millions, towards which Government grants were received amounting to less than 2 millions. Taking elementary, secondary, technical, and higher education together, therefore, local authorities in England and Wales expended in 1908–9 a total sum of 27½ millions, of which the Government contributed just over 13 millions, or 48 per cent., leaving about 14½ millions, or 52 per cent., of the amount to be provided locally.

At the Aberystwyth Conference of the National Union of Teachers, the following resolution, proposed on behalf of the executive, was adopted:—"This conference is of opinion that (*a*) no exemption (either partial or whole time) from school attendance should be granted until the age of fourteen years is attained; (*b*) all wage-earning child labour out of school hours under the age of fourteen should be forbidden by law; (*c*) a system of compulsory attendance at continuation schools from the age of fourteen to eighteen, accompanied by provisions which should safeguard the young people against undue physical or mental overstrain, should be an integral part of a national system of education; (*d*) it should be the statutory duty of the local education authority of each county and county borough to make suitable provision for such further education; (*e*) it should be the statutory duty of every employer of any young person under eighteen years of age (1) to enable him or her to attend continuation classes for such periods of time and at such hours as may be required by the Act, and (2) to supply the names of all such young persons to the local authority on demand; (*f*) all employers should be forbidden under penalty to employ or continue to employ any young person under eighteen years of age who failed periodically to produce a card attesting his or her attendance and good conduct at continuation classes or other educational institutions in conformity with the Act; (*g*) it shall be the duty of the State to make provision for the maintenance of any young person who may be deprived of the means of living as a result of the operation of any national system of education such as is outlined in the foregoing resolutions."

SOCIETIES AND ACADEMIES.

London.

Royal Meteorological Society, April 19.—Dr. H. N. Dickson, president, in the chair.—W. **Marriott**: Variations in the English climate during the thirty years 1881–1910. The Royal Meteorological Society in 1874 commenced the organisation of a series of "second-order stations" at which observations of pressure, temperature, humidity, rainfall, and wind are made twice a day, viz. at 9 a.m. and 9 p.m. In addition to these, another class of stations, termed "climatological," at which observations are made once a day, viz. at 9 a.m., was organised in 1880. The monthly results from all these stations have been published in the "Meteorological Record." The author has taken the general monthly means of all these results as representing the means for England and Wales, and these general means were exhibited to the meeting in the form of an interesting series of diagrams, in which the variations of the various elements for each month were shown in red when above the average, and in blue when below the average, for the thirty years 1881–1910. The warmest months were August, 1899, July, 1900, and July, 1901, while the coldest months were February, 1895, January, 1881, and December, 1890. During the last fourteen years the temperature in October was above the average, with only one exception, viz. 1905. The years with the highest mean temperature were 1898, 1893, and 1899, and the years with the lowest temperature were 1892, 1888, and 1887. The month with the highest mean pressure was February, 1891, and that with the lowest pressure was March, 1909. On the average, April is the month with the least rainfall, and October the month with the heaviest rainfall, while June has the least number of days of rain. The wettest months during the thirty years were October, 1903, and October, 1891, and the driest months were February, 1891, and April, 1893. The years with the heaviest rainfall were 1903 and 1891, and the years with the least rainfall were 1887 and 1893. The wind diagrams showed that the prevailing winds were from the south-west and west, but that in April, May, and June north-easterly winds were more pronounced than in the other months of the year.—Captain C. H. **Ley**: (1) The value of the two-theodolite method for determining vertical air motion; (2) an automatic valve for pilot balloons.

Manchester.

Literary and Philosophical Society, March 21.—Mr. Francis Jones, president, in the chair.—W. **Thomson**: The influence of atmospheric pressure and humidity on animal metabolism. In a previous paper the author stated he had found that the percentage of carbonic acid gas contained in the exhaled air from the lungs was greater when breathing dry than when breathing damp air, also when breathing in mountainous districts where the atmospheric pressure was low than when breathing in the valley, and, again, was greater when breathing in the valley than when breathing at the bottom of a deep coal-pit, where the pressure is still greater. The experiments recorded in the present paper were made upon the exhaled air from three men and one boy, and upon guinea-pigs and mice, and the results from all show that, as a rule, when the barometer fell the percentage of carbonic acid in the exhaled air rose, and when the barometer rose the percentage of carbonic acid fell. As the air became more moist the percentage of carbonic acid fell, and it rose when the air became drier. There was a lower percentage of carbonic acid in the exhaled air when the weather was warm than when it was cold.—Miss Margaret C. **March**: The ornament of *Trigonia clavellata* and some of its derivatives.

April 4.—Mr. Francis Jones, president, in the chair.—Prof. W. W. Haldane **Gee** and A. **Adamson**: Dioptriemeters. The methods of measuring the focal power of thin lenses directly in *dioptrics* have been investigated. In the case of converging lenses, the method of obtaining this value directly from observations on the optical bench is to determine the reciprocal of the focal length in metres by calculation, by scale or table of reciprocals, or by a graphical construction which will enable the value in dioptrics to be read off from a uniform scale placed at right angles to the line along which the focal length has been measured. In the case of concave lenses (as well as converging lenses) the authors have adopted a method originally suggested by Guilloz, but practically unknown in physical laboratories. They have designed an instrument called a "dioptriemeter," which is of great simplicity and convenience. It consists essentially of a scale of concentric circles 1 mm. apart, which is viewed through a pin-hole at a distance of 200 mm. Midway between the pin-holes and scale is a disc with a circular opening of 10 mm. radius, so that twenty circles are seen. If a concave lens be placed against the disc more circles are seen, the excess above twenty giving the power in dioptries. The circles are so numbered that the value is directly read off. The same method is applied to a convex lens. The instrument is especially useful for investigating the properties of cylindrical lenses and the combinations of lenses. It can further be employed for finding the deviation of light by thin prisms and estimating their power in *prism-dioptries*. The method employed in the instrument has been found to be quite as accurate in principle as the usual optical-bench methods for thin lenses.—Prof. E. **Knecht**: The action of hydrogen peroxide on quinone. It was shown that when hydrogen peroxide is allowed to act on quinone in presence of ammonia, the solution becomes heated, and a brisk evolution of oxygen takes place. On acidulating the solution and extracting with ether, hydroquinone was found to have been formed in considerable amount. Toluquinone behaves in a similar way to ordinary quinone.—Dr. A. N. **Meldrum**: The development of the atomic theory: (vi.) the reception accorded to the theory as advocated by Dalton. At first Dalton's physical atomic theory met with keen opposition, and his chemical theory with neglect. To make the chemical theory known required, in addition to Dalton's own efforts, the zeal of Thomas Thomson and the support of William Hyde Wollaston. For years it came to almost nothing, except in Sweden and Italy. In Sweden, J. J. Berzelius, learning of it in the year 1808 from a memoir by Wollaston, received it with enthusiasm, and set himself, with immense success, to test it on the grand scale. In Italy it was the knowledge of Dalton's theory which stimulated Amadeo Avogadro to enunciate and maintain, exactly a hundred years ago, the hypothesis that equal volumes of different gases contain under the same conditions the same number of molecules. This hypothesis, after the lapse of fifty years, became the fundamental dogma of molecular science.

Paris.

Academy of Sciences, April 10.—M. Armand Gautier in the chair.—M. **Gouy**: Intercathodic action in a uniform magnetic field. It has been shown by experiment that intercathodic action is produced when the negative charges are connected by the lines of magnetic force. It is now shown that this condition may be replaced by another which is equivalent to it, that there is a maximum of electric potential on the path of the electrons.—M. **Salet**: The absorption and diffusion of light by meteorites of the intersideral space. The number of meteorites received by the earth in a year has been estimated at over 10^{11}, and their mass to be of the order of 1 gram. If these meteorites do not form a stream displaced with the sun, the number per unit volume in space is of the order of 10^{-8}. Some consequences of the diffusion of light by these meteorites are developed, and also of the bearing on the calculations of Pearson on the standard deviation.—Ch. **Fabry** and H. **Buisson**: Some applications of the phenomena of interference to the study of nebulæ. The method of applying the Fabry interferometer to a telescope is described: interference rings have been obtained with this apparatus from the nebula in Orion without difficulty.—A. **Buhl**: Development of a method due to M. Darboux on the theory of moments of inertia.—M. **Darboux**: Remarks on the preceding note.—André **Broca**: The measurement of geodesic angles by the method of repetition. Construction of a suitable apparatus and results of the measurements. The maximum error found was 1 in 300,000.—J. **Le Roux**: The fundamental covariants of the second order in the finite deformation of a continuous medium.—L. **Hartmann**: The mechanism of the permanent deformation in metals submitted to extension. A study of the manner in which the layer of oxide formed on tempered steel comes off when the elastic limit is passed.—G. A. **Hemsalech**: The line spectrum of air given

by the electric spark. The existence of a second line spectrum of air has been established, emitted exclusively by the oscillations of the electric spark.—P. **Pascal**: Researches on the magnetic properties of fluorine. A detailed study of the magnetic susceptibility of fluorbenzene and parafluorphenetol.—A. **Tian**: The decomposition of water by ultraviolet light. Under the action of the radiations from a quartz mercury vapour lamp, water is decomposed into hydrogen and hydrogen peroxide, the latter, decomposing in its turn, giving rise to oxygen. After a sufficient lapse of time for the equilibrium to be established, the effect of the ultraviolet light is identical, so far as the gases evolved are concerned, with electrolysis.—E. **Fleurent** and Lucien **Lévi**: The estimation of phosphorus in milk. Remarks on a recent paper of Bordas and Touplain.—H. **Jumelle** and H. **Perrier de la Bathie**: The leafless Asclepiads of the west of Madagascar.—Lucien **Daniel**: Biometrical study of the descent of grafted and non-grafted beans.—J. **Granier** and L. **Boule**: The heterogamic character of the *gemini* in *Impatiens glanduligera*.—M. **Truschel**: Contribution to the study of the sense of direction in the blind. A study of what has been termed the "sixth sense" in the blind leads to the conclusion that this is really of an auditive nature.—Armand **Juillet**: Relations between the air sacs and the bronchia in birds.—Jules **Courmont** and A. **Rochaix**: The antitoxic immunisation by intestinal antityphoid vaccination. Intestinal vaccination produces immunity against typhoid toxins and the serum of the vaccinated subjects is antitoxic.—M. **Schaller**: A new arrangement for photographing lesions of the skin or mucous membranes, giving configuration and the value of the morbid colorations.—M. **Weinberg** and A. **Julien**: An example of an acquired immunity towards a verminous toxin.—P. A. **Dangeard**. The conjugation of the ciliated Infusoria.—Ph. **Négris**. The distinctive characters of the breccia arising from the erosion of transported breccia in the Peloponnesus.—J. **Thoulet**: A bathy-lithologic chart of the gulf between Têt and Gruissan.

DIARY OF SOCIETIES.

THURSDAY, APRIL 27.

ROYAL SOCIETY OF ARTS, at 4.30.—The Trend of Mineral Development in India: Sir Thomas Henry Holland, K.C.I.E., F.R.S.

ROYAL INSTITUTION, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

MATHEMATICAL SOCIETY, at 5.30.—A Symmetrical Method of Apolarly Generating Cubic Curves: W. P. Milne.—The Solution of the Homogeneous Linear Difference Equation of the Second Order (Second Paper): G. N. Watson.—A Cartesian Theory of Complex Geometrical Elements of Space: G. B. Mathews.—The Number of Primes of given Linear Form: Lieut.-Col. A. Cunningham.—On the Proofs of the Properties of Riemann's Surfaces discovered by Lüroth and Clebsch: Prof. M. J. M. Hill.—On Properties of certain Linear Homogeneous Substitutions: H. Hilton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Battery Economics and Battery Discharge Arrangements: A. M. Taylor.

ROYAL GEOGRAPHICAL SOCIETY (Research Meeting), at 5.—Recent Progress in Geodesy: A. R. Hinks.

FRIDAY, APRIL 28.

ROYAL INSTITUTION, at 9.—The Revolutions of Civilisation: Prof. W. M. Flinders Petrie, F.R.S.

PHYSICAL SOCIETY, at 5.—High-tension Electrostatic Wattmeters: Prof. Ernest Wilson.—Previous Magnetic History as Affected by Temperature: Prof. Ernest Wilson and L. C. Budd.—Note on the Behaviour of Incandescent Lime Kathodes: Dr. R. S. Willows and T. Picton.—On the Formation of Dust Striations by an Electric Spark: Dr. S. Marsh and W. H. Nottage.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Gas-producers: J. Emerson Dowson.—The Effect of Varying Proportions of Air and Steam on a Gas-producer: E. A. Allcut.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Commercial and Technical Relations of Engineering Design and Work: T. Frame Thomson.

MONDAY, MAY 1.

ROYAL SOCIETY OF ARTS, at 8.—Rock Crystal: its Structure and Uses: Dr. A. E. H. Tutton, F.R.S.

SOCIETY OF ENGINEERS, at 7.30.—The Protection of Water Supplies: H. C. H. Shenton.

ARISTOTELIAN SOCIETY, at 8.—A New Law of Identity: Miss Constance Jones.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Testing of Creosote: C. Edward Sage.—A Modification of Raschig's Theory of the Lead Chamber Process: E. Divers, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—Notes on the Insurance Act 1910, Dominion of Canada: T. Bradshaw.

TUESDAY, MAY 2.

ROYAL INSTITUTION at 3.—The Decay of Idealism in France and of Tradition in England: J. E. C. Bodley.

FARADAY SOCIETY, at 8.—Hydro-electric Plants in Norway and their Application to Electrochemical Industry: A. Scott-Hansen (Christiania).—Electro-metallurgy in the Steel Foundry: Verdon Cutts.—Two Simple Forms of Gas-pressure Regulators: Edgar Stansfield.

WEDNESDAY, MAY 3.

ROYAL SOCIETY OF ARTS, at 8.—Improvements in the Transport and Distribution of Goods in London: A. W. Gattie.

ENTOMOLOGICAL SOCIETY, at 8.—South African and a few Australian Aculeate Hymenoptera in the Oxford Museum: the late Col. C. T. Bingham.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Evaluation of certain Salts used in Medicine: J. C. Umney and C. T. Bennett.—Absorption of Dissolved Oxygen by Sewage Effluents and the Royal Commission's Provisional Standard: E. Halliwell.—The Detection of Traces of Hydrogen Cyanide: Dr. G. D. Lander and A. E. Walden.—(1) Note on the Composition of "Blaud's Pills"; (2) Note on the "Pearl Coating" of Pills.—A. E. Parkes and J. D. Roberts.—A Reaction for "Caulophyllin."—J. F. H. Gilbard.

THURSDAY, MAY 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Some Phenomena of Regeneration in Sycon, with a Note on the Structure of its Collar-cells: J. S. Huxley.—Cancerous Ancestry and the Incidence of Cancer in Mice: Dr. J. A. Murray.—Motor Localisation in the Brain of the Gibbon correlated with a Histological Examination: Dr. F. W. Mott, F.R.S., Dr. E. Schuster, and Prof. C. S. Sherrington, F.R.S.—Immunisation by means of Bacterial Endotoxins: Dr. R. T. Hewlett.

ROYAL INSTITUTION, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

LINNEAN SOCIETY, at 8.—On John Vaughan Thompson and his Polyzoa and on Vaunthompsonia, a Genus of Sympoda: Rev. T. R. R. Stebbing, F.R.S.—On Polytrema and somn Allied Genera: Prof. Sidney J. Hickson, F.R.S.—Observations on some New and Little-known British Rhizopods: J. M. Brown.—The British Museum Collection of Blattidæ enclosed in Amber: R. Shelford.—Freshwater Algæ collected in the South Orkneys by Mr. R. N. R. Brown: Dr. F. E. Fritsch.

RÖNTGEN SOCIETY, at 8.15.—The Use of Radium in Malignant Growths: C. W. Mansell Moullin.—Rapid Radiography: Ed. S. Worrall.

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 9.—New Organic Compounds of Nitrogen: Prof. M. O. Forster, F.R.S.

CONTENTS.

THURSDAY, MAY 4, 1911.

THE GOLDEN BOUGH.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. Third edition. Part i. (in two vols.), The Magic Art and the Evolution of Kings. Vol i., pp. xxxii+426. Vol ii., pp. xi+417. (London: Macmillan and Co., Ltd., 1911.) Price 20*s.* net, two vols.

THE third edition of Prof. Frazer's book will be in six parts, comprising at least seven volumes. As the subject of "the dying god," to which the last four parts will be devoted, has proved, in the author's words, to be "a fruitful subject," the number of volumes will probably reach a total of nine. The two volumes of the first part, which lie before us, contain more than eight hundred pages of octavo.

In its new form of "a series of separate dissertations loosely linked together by a slender thread of connection" with the original subject (to which the book owes its title), it has been resolved into its elements. But the result is that we have a closer study of each element, while the whole inquiry actually gains in organic unity. Thus in the two volumes of the first part, dealing with "The Magic Art, and the Evolution of Kings," the space devoted to these subjects in the second edition is more than doubled, but we have a fuller analysis of each on one hand, and on the other we gain a clearer notion of the passage from magical control of the forces of nature to the system of Departmental Gods.

This first part presents no striking newness of theory as did the second edition. The author has been credited with a proneness to hypothesis to which actually he is not liable. There are few writers who are more content to be led by the facts. But interesting subjects which before were incidentally treated are now more or less exhaustively studied. Such are "The Sacred Marriage," or "The Marriage of the Gods," "The King's Fire," "The Fire Drill," "Father Jove and Mother Vesta," and "The Origin of Perpetual Fires." The latter group was the subject of one of the author's earliest papers, printed in *The Journal of Philology,* in which, among other results, he exposed the unscientific character of the orthodox German school of mythological inquiry.

Some new terms are introduced. Magic is divided into homœopathic and contagious. The former "commits the mistake of assuming that things which resemble each other are the same"; the latter assumes "that things which have once been in contact with each other are always in contact." The latter, again, generally involves an application of the former. The older term, imitative, obscured the mechanical nature of sympathetic magic, but the above description seems to show that the new terms are far from satisfactory. The former suggests to the ordinary student a theory of medicine, the latter a theory of disease; and thus a wrong impression of the nature and application of magic may be conveyed. There is also a good deal more to be said on the origin and meaning of these primitive forms of the inductive methods, than is given either by the author or by Mr. Hirn, to whom is due the term homœopathic. In fact, there is a fruitful field here awaiting the psychologist. The methods of primitive thought, adequately analysed, would throw light on much that is obscure in the evolution of logic and the elementary processes of mind.

After all the details recounted so minutely and illustrated so clearly by Prof. Frazer, one still does not really understand either the meaning or mental process of the savage principle that "things which have once been in contact with each other are always in contact." No academic principle of association of ideas will help us here, nor even the author's happy comparison with modern physical theory, "the impulse being transmitted from one to the other" (of two things in magical rapport)

"by means of what we may conceive as a kind of invisible ether, not unlike that which is postulated by modern science for a precisely similar purpose, namely, to explain how things can physically affect each other through a space which appears to be empty."

The savage does not so think, and Prof. Frazer does not suggest that he does so think, of the matter of "secret sympathy." Is it not more probable, for example, that a solution of the problem will begin with the obvious fact that in these matters the elemental intelligence simply ignores the categories of space and time?

Under magic is included an interesting suggestion as to the origin of circumcision, originally put forth by the author in *The Independent Review.* The suggestion is that the mutilation was

"originally intended to ensure the re-birth at some future time of the circumcised man by disposing of the severed portion of his body in such a way as to provide him with a stock of energy on which his disembodied spirit could draw when the critical moment of reincarnation came round."

The question raised is applicable generally to the method of "The Golden Bough," and the author's other work in the explanation of origins. The point is not whether barbarous or civilised men can or do continue to practise such operations as painful mutilation because of a superstitious fancy or religious dogma—that is abundantly proved in human history. The point is, Did primitive men, not far removed from *Homo alalus, institute* such mutilations for so slender and so unpractical a reason? Any *a priori* discussion of the point must take into account the fact that such rites are always organised by the old men, and also the possibility that they were instituted at a stage of culture very little less advanced than that in which we see them now.

In an analogous problem, Prof. Frazer observes:—

"While I have shown reason to think that in many communities sacred kings have been developed out of magicians, I am far from supposing that this has been universally true. The causes which have determined the establishment of monarchy have no doubt varied greatly in different countries and at different times."

L

It is difficult to imagine *any* kingship at any period or in any country being originally instituted for any other reason than the practical need of a *leader.* Facts, however, show that other reasons, of superstition, have actually operated.

"Writers," says the author, "on the origin of political institutions . . . have not laid their account sufficiently with the enormous influence which superstition has exerted in shaping the human past."

Of course, the solution of the difficulty is that, when superstition creates a monarchy, it *does create a leader,* whose power is no less real because it is merely magical. Once more, we may note that such questions invite the attention of the psychologist, in this case the student of the mind of society rather than of the individual.

This new edition is, as we have hinted, something more than a mere enlargement. It is a new book, or a series of books; yet it is the same "Golden Bough." The reader will find it full of good things, new and old. He will also realise that "The Golden Bough" is a great book, one of the great books of our time. As such, it has a character and an aim. It is extraordinarily simple, hence its powerful appeal. Every fact is presented, as it might be by a demonstrator, completely, minutely, and luminously; but each fact is a human document. The aim of the book has, perhaps, grown with its growth; the author's words, cited above, may describe it:—To show "the enormous influence which superstition has exerted in shaping the human past." There is, indeed, no better introduction to the social and political history of the world than "The Golden Bough"; it is a book every statesman should be acquainted with, for it enables us to understand something of the workings of the mind of man in the mass, not only when it leads us from early savagery to the great world-religions which still exercise a profound influence on man's fate, but also when it deals with politics. Men in the mass are nothing if not superstitious, whether the superstition be a religious dogma or a political principle. It is not too much to say that this book, now in its majority—the first edition was published in 1890—has already helped the world towards a scientific view of nature and of man, the lack of which has made history a panorama of atrocity and error.

A. E. CRAWLEY.

AN INDIAN FOREST FLORA.

A Forest Flora of Chota Nagpur, including Gangpur and the Santal-Parganahs: a Description of all the Indigenous Trees, Shrubs, and Climbers, the Principal Economic Herbs, and the most commonly cultivated Trees and Shrubs. By H. H. Haines. Pp. vii + 634 + xxxvii. (Calcutta: Superintendent of Government Printing, India, 1910.)

THE author of this work, who has served largely and travelled extensively in the region with which it deals, and has studied its vegetation long and carefully, ought to be well qualified to give a satisfactory account of its flora. That area constitutes the north-eastern portion of the highland region of Central India, which forms part of the province of Bengal. It includes the administrative division of Chota Nagpur with the tributary State of Gangpur in its south-western border, and one other district—the Santal-Parganahs to the north-east—which belongs to the Bhagalpur division. This district, though an outlying one from the point of view of the administrator, is topographically and botanically an integral part of the upland tracts to the west of the Lower and to the south of the Upper Gangetic Plain. Its annexation is therefore fully justified on scientific grounds; and, as the work is prepared primarily with reference to forest requirements, has the practical advantage of enabling the author to deal with all the western forest subdivisions of Bengal.

In his treatment of the task before him the author does not disappoint us. The concise and well-arranged introductory remarks show that he is intimately acquainted with his country, and fully appreciates the factors which have determined the character of its vegetation. One only regrets that departmental exigencies have debarred him from dealing with those elements which fall outside the category of "economic" plants, and from giving us the complete review of the flora which he is so clearly competent to provide.

The technical portion of the work affords constantly recurring evidence of careful and independent study, and demonstrates that it is in no sense a compilation. Where his field observation of critical species has led him to adopt individual views, these are stated with judgment and caution. There are doubtless cases in which those with material from more extended areas before them may not be able to accept the author's conclusions; even so, the close study on which these conclusions have been based will still be fully appreciated. We may doubt, more particularly, whether the author has done well in departing from the sequence of the natural families observed in most standard Indian floras. No serial presentation of natural units can be wholly satisfactory, and the question is not as to whether the sequence adopted by the author be an improvement on the sequence it replaces, but whether the adoption of an improved sequence, in a work of "local" scope, can compensate for the inconvenience which results when that work has to be consulted simultaneously with another treatise of a more "general" nature.

The characters given for the species, if few and briefly stated, are well selected and clearly expressed. The economic notes and the local names, which are added when possible, increase the practical value of the work; this is further enhanced by the addition of an excellent map. This map, prepared by the Forest Survey, and published by the Survey of India, is worthy of these two State departments, but the appearance of the book itself is unattractive and disappointing. In spite of this drawback, however, our author's flora cannot fail to prove a useful companion to those resident in the area with which it deals, who may be interested in its vegetation.

ORDERS OF INFINITY.

Orders of Infinity: the "Infinitärcalcül" of Paul du Bois-Reymond. By G. H. Hardy, F.R.S. Pp. iv+62. (Cambridge: University Press, 1910.) Price 2*s.* 6*d.* net.

THE subject of this tract has been hitherto inaccessible to English readers, and it is not altogether easy to give a brief account of its contents. Perhaps the simplest method is to start from the familiar facts that log x and e^x both tend to infinity with x, but in very different ways, namely, $(\log x)/x^\delta$ tends to zero, however small δ may be, and e^x/x^Δ tends to infinity, however large Δ may be (it is understood that δ, Δ do not vary with x). These results would be expressed in du Bois-Reymond's notation by the symbols

$$\log x \prec x^\delta \text{ and } e^x \succ x^\Delta;$$

in addition to these two symbols, du Bois-Reymond used another to imply that the ratio of two functions f, ϕ lies between finite limits (when x tends to infinity). But later writers have found it convenient to make the notation rather more precise, and to write

$$f \asymp \phi$$

to imply the relation just mentioned, and further to use $f \sim \phi$ to imply that lim $(f/\phi)=1$; there are also other sub-cases for which reference must be made to Mr. Hardy's tract.

The ideas mentioned above lead very naturally to the *logarithmic scale of infinity*, represented by the sequence of functions

$$\ldots, l_3x, l_2x, l_1x, x, e_1x, e_2x, e_3x, \ldots$$

where

$$l_nx = \log(l_{n-1}x),\ l_1x = \log x,$$

and

$$e_nx = \quad (e_{n-1}x),\ e_1x = e^x.$$

This scale has the property that any element tends to infinity more slowly than any positive power δ of the following element, and more rapidly than any positive power Δ of the preceding element; and it is possible to utilise the scale to classify all ordinary functions of analysis. Mr. Hardy has considered (pp. 16–36) the question as to what more or less artificial functions do and do not fall into place in the scale; we must content ourselves with mentioning the comparatively simple function $\Sigma x^\nu/\nu\,!$ obtained by selecting certain terms from the exponential series; this *does* fit into the scale if ν takes the values 1, 4, 9 . . . $(\nu=n^2)$ but does *not* if ν has the values 1, 8, 27, . . . $(\nu=n^3)$, nor if $\nu=1, 2, 4, 8, \ldots (\nu=2^n)$.

In Appendix ii. (pp. 48–57) Mr. Hardy has made a most interesting summary of recent results in analysis, in which du Bois-Reymond's ideas have proved helpful, and readers who are less interested in logic than in results may be advised to turn to this appendix first. Appendix iii. gives a large variety of numerical results to emphasise the amazing rapidity of increase of the logarithmic scale at the upper end, and its corresponding slowness of increase at the lower end.

We may, perhaps, quote the largest number suggested by physical considerations, namely, the number of molecules in the earth, which is found to be of the order

$$1{\cdot}08\times 10^{51} \text{ or } 42\,! \text{ or } e_2(4{\cdot}77).$$

This is considerably larger than the number of sodium wave-lengths which light could traverse in geological time, a number of the order 30! or $e_2(4{\cdot}32)$. Both of these numbers are quite small when expressed in terms of second order exponentials, and are far smaller than 9^{9^9}, the largest number expressible in terms of three digits; this last number contains 369,693,100 digits when written at full length, and (printed with 16 digits to the inch) would cover more than 350 miles.

T. J. I'A. B.

MAYA ASTRONOMY.

The Numeration, Calendar Systems, and Astronomical Knowledge of the Mayas. By C. P. Bowditch. Pp. xviii+346+xix plates. (Cambridge: University Press, 1910. Privately printed.)

THIS volume offers to the reader "a statement of the knowledge which we possess of the numeration, calendar, and astronomical attainments of [a] wonderful people."

The sources of information are primarily the records of the Mayas themselves; secondarily, the writings of Spaniards and others about the Mayas. The first source may be subdivided into:—

(i) The books of Chilan Balam.
(ii) The codices.
(iii) Inscriptions.

The Book of Chilan Balam of Mani (Mani being the name of a village added to the title for the purposes of identification) was composed before 1595. All books of this class were copies of older manuscripts, with occasional addenda of current interest. They were regarded with superstitious veneration by the village to which they belonged.

The codices, of which three are extant, contain accounts of Mayan histories, ceremonies, sacrifices, and calendar.

Bishop Landa, at Mani, in 1562, carried out so far as possible a "general destruction of everything which related to the ancient life of the nation." He was a Franciscan friar, and subsequently became Bishop of Yucatan. He was a sincere friend and protector to the natives; he has preserved the Maya alphabet, and with it the key to the inscriptions, a service which "wipes out over and over again his faults, which were those of the century."

The Mayas used a series of twenty day-names in an invariable order, Kan, Chicchan, &c., the first following the last without a break, just as the days of the week do with us. The period of twenty days is referred to as a month.

In addition to this, a device was used of counting up to thirteen, and then beginning again, so that the complete cycle becomes 260 days; just as we should have a complete cycle of 210 days if every month contained thirty days, and if it were usual to name only the day of the week and the day of the month without naming the month. The series of 260 days is called Tonalamatl.

As an illustration of the ingenuity that has to be applied in deciphering the results, we transcribe here from p. 28 an example in which we have merely changed the notation for the convenience of printing. Thus we use four symbols, p, q, P, Q, where the original uses lines and dotes either black or red. We have replaced red signs by small letters, black signs by capitals, dots by p or P, lines by q or Q. We use brackets to divide one group of symbols from another. Then we have to decipher (p)(PPQQQ)(q)-(PPPPQQQ)(pqq)(PQ)(pppp)(QQ)(p). The following interpretation may be considered correct, because it makes sense (the process may be compared with solving an equation by trial and error):—Let p or P denote unity, q or Q denote five; then the sentence reads: One, add seventeen, leaves remainder five; add, nineteen, leaves remainder eleven; add six, leaves remainder four; add ten, leaves remainder one. By "leaves remainder" we mean on dividing by thirteen. It is, as we might say, Sunday; in ten days it will be Wednesday; in five more, Monday; in twelve more, Saturday; and in eight more, Sunday again.

With this sample of the contents we must leave the book to our readers. Some will, no doubt, be interested in the problems of decipherment, others in the results obtained; perhaps still more will feel that they cannot be interested in everything, and other problems and other people have greater claims upon their attention. The world at large would regret to see any branch of knowledge die out or remain stationary, and will, in consequence, feel grateful to the author for his labours.

A MONOGRAPH OF DENDROBIUM.

Das Pflanzenreich, Regni vegetabilis conspectus. Edited by A. Engler. N. 50, II., B. 21, Orchidaceæ, Monandræ, Dendrobiinæ. Pars i., genera n. 275–277. By Fr. Kränzlin. Pp. 382. (Leipzig: W. Engelmann, 1910.) Price 19.20 marks.

THE present volume is the forty-fifth of a series of monographs, comprising the "Pflanzenreich," and the third which deals with the great family of orchids. Of the three latter, the few diandrous genera formed the subject of the first, the work of the late Prof. Ernest Pfitzer, while the second volume, begun by Pfitzer, and completed by Dr. Kränzlin, dealt with the small group of the Coelogyninæ. The bulky "Heft" by Dr. Kränzlin, which is the subject of this notice, is devoted to the great genus Dendrobium and its immediate allies. It is evident therefore that there is still very much to be done before we have, what has been a desideratum since the time of Lindley, a complete monograph of this large and important natural order.

The plan of arrangement of tribes and genera adopted in the "Pflanzenreich" is that which was elaborated by Pfitzer in his account of the Orchidaceæ in the "Pflanzenfamilien." Dr. Kränzlin, however, takes a somewhat different view of the limitations of genera. He is here treating of that portion of the section Dendrobiinæ which is characterised by the presence in the anthers of four pollinia without appendages, and in Pfitzer's arrangement included three genera, Latourea (a monotypic genus), Dendrobium (with 300 species), and Aporum (with twelve species). Dr. Kränzlin points out that the first of these was founded on a misconception, and must be regarded as a synonym of the larger genus, in which he also includes the small genus Aporum. On the other hand, he finds reason for resuscitating the very doubtful genus Callista of Loureiro, which depends on a fragmentary specimen of Loureiro's in the British Museum herbarium, and the genera Sarcopodium of Lindley and Desmotrichum of Blume. He also raises to generic rank the sections Inobulbon and Diplocaulobium, and maintains the genus Adrorhizon, founded by Sir Joseph Hooker on a single species from Ceylon.

The number of species admitted is more than double the estimate given by Pfitzer in the "Pflanzenfamilien" in 1889. The great genus Dendrobium includes more than 600 species, which are distributed among ten subgenera, and the grand total of species contained in the seven genera recognised is more than 700. This great increase in number of species is an index of the large and widespread interest which has been taken in the family of orchids during the last twenty years, a period which, by a strange coincidence, starts from the date of the abrupt termination of the work of the younger Reichenbach. During the whole of this period Dr. Kränzlin has been working continuously and steadily on the order, and with the completion of his monograph of one of the largest genera, as well as one of great interest, to botanists and horticulturists, he has earned a new debt of gratitude from workers both in the pure and applied aspects of the science. A. B. R.

ANTHROPOLOGY.

History of Anthropology. By Dr. A. C. Haddon, F.R.S., with the help of A. H. Quiggin. Pp. x+158. (London: Watts and Co., 1910.) Price 1s. net.

THIS is a fascinating little volume, and deals in a masterly manner with the history of anthropology in so far as that can be done within the compass of some 150 pages. Anthropology is now so vast a subject that it is necessary for the individual student, if he wishes to become a specialist, to confine his attention to a comparatively small fraction of the whole, and very often the specialist in one department knows little or nothing of what has been done in other departments. To such specialists this short history will be of the greatest value, and the science of anthropology as a whole will benefit by the coordination of results obtained in different departments.

The authors divide their subject into the two main divisions of physical anthropology and cultural anthropology, and these again are divided into chapters with somewhat eclectic titles, dealing with the more important and interesting sections. We have, for example, chapters on the "Pioneers of Physical Anthropology," "Anthropological Controversies," and "The Unfolding of the Antiquity of Man," under the

first division; and chapters on "Ethnology, "The History of Archæological Discovery," "Technology," and "Sociology and Religion," under the second division.

It is, we think, unfortunate that the authors have to a great extent followed the somewhat confused and redundant classification of Dieserud, in the subdivision of their material; it is impossible, for example, to prevent some overlappng in chapters dealing with "The Unfolding of the Antiquity of Man," and "The History of Archæological Discovery." Similar difficulties are met with in connection with other chapters in the book. The question of the classification of the subject-matter of anthropology is confessedly full of difficulties, and the authors no doubt found themselves to a certain extent tied down to the illogical systems at present in use.

The authors confess that their limited space necessitated many omissions, but we were surprised to find no mention of the Gibraltar skull in the chapter on "The Antiquity of Man." The chapter on "Anthropological Controversies" is full of interest, as showing how theology, politics, and economics interfered with the progress of the science.

There have been few, if any, complete histories of anthropology published before the appearance of this work, and the origin of each branch of this subject is so thoroughly explored to its source, that, we are impressed with the fact, that a great deal of original historical research must have been carried out by the authors in the collection of their material.

SOME BOOKS ON CHEMISTRY.

(1) *Inorganic Chemistry for Advanced Students.* By the Right. Hon. Sir H. Roscoe, F.R.S., and Dr. A. Harden, F.R.S. 2nd edition. Pp. viii+476. (London: Macmillan and Co., Ltd., 1910.) Price 4*s.* 6*d.*

(2) *Chemistry for Beginners.* By T. Jenks. Pp. x+309. (New York: F. A. Stokes Co.; London and Edinburgh: W. R. Chambers, Ltd., 1910.) Price 3*s.* 6*d.* (Chambers's Wonder Books.)

(3) *The M.C.C. Periodic Chart of the Elements.* Pp. 45 (introduction) and chart (folded and bound). (London: Metallic Compositions Co., n.d.) Price 8*s.* 6*d.*

(1) THE new edition of Roscoe and Harden's "Inorganic Chemistry for Advanced Students" differs from its predecessor (reviewed in NATURE of December 7th, 1899), mainly in the addition of new lessons or chapters on carbon compounds and on the radio-active elements. It is, however, very gratifying to see the new method of making hydrazine from ammonia incorporated so quickly in a text-book, and to find calcium cyanamide duly described as an inorganic compound amongst the compounds of calcium in a chapter which includes a brief but accurate description of the technical preparation of the metal by electrolysis of the fused chloride. The lesson dealing with crystals and isomorphism remains in some need of revision, as three distinct methods are used to indicate the faces of the crystals in the various diagrams that are reproduced; as the symbols used are not explained the simplest remedy would probably be to omit them altogether from the diagrams. The issue of the new edition has supplied an opportunity for introducing the system of atomic weights in which $O=16$ instead of $H=1$, and these values are now used throughout the book. The larger volume is intended to be used as a sequel to Roscoe and Lunt's "Inorganic Chemistry for Beginners," and an element such as chlorine, which has already been described in the smaller volume, is now referred to only under its metallic derivatives. In this way space has been saved for the introduction of more advanced work than could otherwise have been included within the limits of less than 500 pages.

(2) The "Wonder Book" on chemistry is the third venture which the author has made in seeking to interpret to the non-technical reader some of the more important facts and theories of modern science; the preceding volumes on electricity and photography are dedicated to "Young Readers"; the third volume is for "Beginners." The story is a readable one, and the statements made are usually accurate, at least when dealing with the facts of chemistry; the introduction of theories is responsible for a certain number of errors, as, for instance, where the existence of monatomic molecules is denied (p. 67), or ions are described as "even smaller than atoms" (p. 243); but the author has not hesitated to introduce his youthful readers not only to the atomic and molecular theories, but also to the periodic law and the theory of electrolytic dissociation. A less ambitious programme might have deprived reader and writer alike of the satisfaction of having covered the whole of the subject; but it is precisely because such a sense of perfected knowledge might arise after a perusal of the volume that one would hesitate to commend it to any but the lay reader who intends to remain a layman. As an introduction to the further study of chemistry its value would be very doubtful, since a teacher would probably prefer to deal with a beginner who had not made any attempt to study the subject rather than with one who had imbibed the theories somewhat vaguely outlined by the author. The book is well illustrated, and contains an excellent series of portraits of famous chemists, from Priestley to Mendeléeff.

(3) "The Chart of the Elements," compiled by the Metallic Compositions Company, is intended to summarise in diagrammatic and tabular form the properties of the elements as elucidated by the periodic system. It is intended largely for non-chemical readers who have occasion to make use of metals in various ways, and desire to know something of the properties of related elements which may possibly prove to have valuable technical qualities. An introduction of forty-eight pages is provided, the second part of which, on "The Periodic Law and its relation to Speculative Thought," differs fundamentally from the earlier descriptive and explanatory pages and reveals the author at work on what is evidently a favourite hobby or recreation.

T. M. L.

OUR BOOK SHELF.

Das Radium in der Biologie und Medizin. By E. S. London. Pp. vi+199. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1911.) Price 6 marks.

In the fourteen years since the discovery of radium a large mass of observations has arisen on the effects of radium rays on the various tissues of the living organism. The present work aims at collecting data from the publications of all countries and systematising the results obtained with normal as well as pathological tissues; and the effects on plants and animals as well as on man. The author expresses his keen desire to arrange his material so as to show some definite general principles resulting from the physiological actions of radium rays. Unfortunately he has had to own himself quite unable to achieve this ambition. He has therefore decided to divide the work into a biological and a medical section, and to divide each of these into an experimental and a clinical side. The work does not pretend to be a text-book; it is offered merely as a complete compilation up to date.

The physiological properties of radium rays are fully described, including the decomposition of lecithin, with the separation from it of cholin, a substance which is capable of producing considerable changes in the organism. The author then passes on to the action of radium rays on bacteria and on the lower fungi. The results here are not very striking. In dealing with the ferments, toxins, and antitoxins of the body, some very interesting facts are brought to light, and it is shown that radium, whether inhaled or injected in the form of solutions of emanation, has the power of increasing the activity of certain of the body's ferments. Other ferments appear actually to be reduced in activity by radium rays. This leads us to the recent use of radium and of radium emanation in the treatment of gout, in which perfectly definite results have already been obtained, although far more observations are required before this treatment can be applied extensively. The action of radium on the skin and on cancerous tissues is also fully described.

The book is a careful and conscientious compilation, and must prove of great value to those engaged in practical work with radio-active substances. A. C. J.

Die Adamellogruppe, ein alpines Zentralmassiv, und seine Bedeutung für die Gebirgsbildung und unsere Kenntnis von dem Mechanismus der Intrusionen. By W. Salomon. II. Teil, Quartär, Intrusivgesteine. Pp. vi+435–603+Taf. ix–xi. (Wien: R. Lechner (W. Müller), 1910.) Price 12 kronen.

The first part of Herr Salomon's great monograph on the Adamello group was noticed in our columns on July 22, 1910. In this second one he describes the diluvium (for he retains this term consecrated by ancient error), such as the different types of moraines, the erratics from the central mass (which have been carried far), and the erosive effects of the ice. In regard to the last, considerations of space forbid us to say more than that he has a firm faith in the excavating powers of glaciers, and regards them as agents of no small importance in the sculpture of the Alps. The remaining and larger portion is devoted to a study of the intrusive rock of the *massif* and its enclosures. The former, as might be expected, exhibits several varieties, which are often closely associated, and indicate a differentiation in the original magma, before it arrived at its present position, with an approach to solidification in the more basic portions. Thus sometimes the latter have been carried away as actual fragments (not very happily named *Lacerationssphäroide*) in the more liquid material, while sometimes a kind of mottling or streaking is produced, as may be seen in the Guernsey diorite. Not seldom also the rock is cut by aplitic and pegmatitic veins, representing the most acid residue, as the fragments do the earliest and most basic segregate. Of these we find some excellent photographs, with others of a more general character.

Every detail is so elaborately worked up that the memoir bids fair to rival the mountain in magnitude, and we cannot but think, since the counterparts of many of the facts occur elsewhere in well-known places, that greater brevity would have been an improvement. These monumental memoirs, thought containing much that is really valuable, sometimes tempt the student to doubt, as in the well-known instance, whether it is worth going through so much to get to so little.

Cassell's Cyclopaedia of Photography. Edited by B. E. Jones. Part i. (London: Cassell and Co., Ltd., 1911.) Price 7*d.* net.

Messrs. Cassell's "Cyclopædia of Photography," of which the first part is before us, is edited by Mr. Bernard E. Jones, who is assisted by about twenty "chief contributors," well known in the photographic world in connection with that particular branch of the subject that each is associated with. The work is to be completed in twelve parts, to be published at fortnightly intervals. The editor aims at including every accepted photographic term, and at paying particular attention to the requirements of both amateurs and professionals. As an indication of the wide range of subjects included, we give the headings that occur on the first page of the first number:—"Abat-jour," "Abaxial," "Abbe Condenser," "Abbe, Ernst," "Aberration," "Abrading Powder." The articles in this number that exceed one page in length, are titled:—"Acetylene Generator," "Albumen Process," "Aphengescope," and "Autochrome Process."

New Ideas on Inorganic Chemistry. By Prof. A. Werner. Translated, with the author's sanction, from the second German edition, by Dr. E. P. Hedley. Pp. xvi+268. (London: Longmans, Green, and Co., 1911.) Price 7*s.* 6*d.* net.

The first German edition of Prof. Werner's treatise was reviewed in these columns on March 8, 1906 (vol. lxxiii., p. 433). As compared with the first, the second German edition was to a great extent rewritten, and in part extended. The chief object of the revision was the harmonising of the sections discussing the problem of valency. New sections on work done between the dates of the two editions were added. But on the whole the book has preserved its original character. An index would add to the usefulness of the work.

The Natural History of Selborne. By Gilbert White. With Notes by Richard Kearton, and 123 illustrations and photographs by Cherry and Richard Kearton. Pp. xvi+294. (London: Cassell and Co., Ltd., 1911.) Price 3*s.* 6*d.*

The first edition of this very attractive production of a widely known classic was reviewed in the issue of Nature for March 5, 1903 (vol. lxvii., p. 419). The fact that the book has been reprinted three times since then shows that the notes and illustrations of Messrs. Kearton have been very successful in extending the knowledge of White's letters on natural history.

How to Build an Aëroplane. By Robert Petit. Translated from the French by T. O'B. Hubbard and J. H. Ledeboer. With 93 illustrations. Second edition. (London: Williams and Norgate, 1911.) Price 2*s.* 6*d.* net.

The present differs in no essential respects from the first edition, reviewed in Nature of August 25 last (vol. lxxxiv., p. 229). The translators have not felt justified in incorporating details of the numerous variations of original types of aëroplanes.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Caliature Wood.

DURING the preparation for the press, in 1895, of the "Diary and Consultation Book of the Agent, Governor and Council of Fort St. George," for 1682–5, Mr. A. T. Pringle, the editor, inquired if I could throw any light on the origin of caliature, a name for redwood (*Pterocarpus santalinus*), frequently referred to as an article of trade in Madras. Presuming the name to be that of a port on the east coast, it has evidently disappeared from nearly all the available gazetteers and modern atlases. Inquiries were made in London, Holland, and Java with no results; but recent researches in the libraries of Calcutta have been more successful, and the following notes on the early trade of the country form an interesting chapter on the history of red-sanders wood.

To Rumphius belongs the credit of giving the origin of the term "caliture." In "Herbarium Amboiense," 1750, vol. ii., 48, he speaks of "Santalum rubrum" being known in his country and in Europe, and as coming from a tree from which "lignum calitour" is derived. The wood is very hard, solid, and dull-red, which he says could be obtained in great abundance from the northern parts of the Coromandel coast. Various kinds of furniture were made of it, as benches and elegantly carved chairs. Only the mature trees afforded good sandalwood, as was shown in letters sent to him in 1689. The wood was also used as a tincture in the arts, and the Armenians in Shiraz and Ispahan added it to distilled spirit of wine to give it a beautiful and intense red colour. The identity of the town by Rumphius I will quote in the original Latin:—"Hisce addo ex iisdem litteris locum Caliatour quondam dictum, hodie in ora Coromandelensi hoc nomine non amplius esse notum, sed tempore mutatum fuisse in *Krusjua-Patanum*, seu *Kisjua-Patan*, ita ut primi nominis memoria inter Europæos tantum conservetur."

The town of Kistnapatam, referred to in this paragraph, is in the Nellore district of the Madras Presidency. It is now a village, situated at 14° 17′ north latitude, 82 miles north of Madras; it has a fine backwater of great depth, and is a shelter for native craft during the monsoon. In an old glossary it is said to be the Greek σωπατρα, and "title otherwise Calitore." In a map accompanying "A True and Exact description of the most celebrated East India Coasts of Malabar and Coromandel" (1672), by (Rev.) Philip Baldæus, Callerture is shown between Armagon and Penne (Penner River). In a map of the "Peninsola deli India" (dated 1683), by Giacomo Cantelli da Vignola, a Portuguese, the town is indicated as "Caletur." It is evident that while the town was known to foreigners as Calitore or Caletur, it was not recognised by that name by the British factors.

The trees yielding red sandal-wood occupy a small area including portions of the Cuddapah, Nellore, and North Arcot districts, chiefly on the Sashachellam, Lankamali, and Veligonda ranges of hills. Mr. Gamble remarks that "in range there is perhaps no important Indian tree of so circumscribed a distribution." We need not suppose that the area under *P. santalinus* has shifted its position during the past two hundred years. A glance at the map of India will show that produce from this area would find outlets on the coast at Caleture, Armagon, and Pulicat, frequented by Dutch ships in the seventeenth century. Turning to the text of Baldæus's description of the Coromandel coast, we do not, however, find reference to the trade in redwood, but on p. 654 he says that between "Penna and Caleture" the best "Essaye Roots" are found, referring to chayroot (*Oldenlandia umbellata*); and he refers to the bark of a tree, of a darker colour, which is probably *Ventilago madraspatana*. Numerous vegetable dyes must have been in use at this time to prepare the large quantities of coloured cotton goods exported from this coast.

The earliest English factory was planted in 1625 at Masulipatam, where trade was carried on with varying fortune for several years. In 1628 the agent, pressed by the Dutch rivalry, migrated southwards to Armegam. In 1639 Armegam in its turn gave way to Fort St. George, Madras, which in 1653 was raised to the rank of an independent presidency. Between this young growing factory and the Court of the Hon. East India Company there was considerable correspondence, and interesting extracts are made in the Diary and Consultation Book of the Agent and Governor. In their despatch dated February 8, 1681, the Court wrote as follows:—"And we do further order that you make the like provision of 300 tons Reddwood for our next yeares shipping. The Dutch call this Reddwood by the name of Calliature wood, and we do p̄ the Nathaniell and Williamson send a pattern therof which came from India. We are informed that it costs about 2½ Pag° p̄ candy, they are usually in pieces of about 3 yards long but you may have it sawed into pieces of about 2 foot more or less as the Comanders shall desire for conveniency, it being to be ground to powder here and used in dying."

Contracts for the supply of the wood were negotiated by the Governor, and the question of advances was settled with the merchants. In September, 1682, the following entry in the Diary occurs:—"The Calliature or Redwood merchants having made a contract with yᵉ Agent, &c., for — candy of red wood, declared that without they might have half the money before hand they could not comply with their contract wᶜʰ upon their promise of giving security was granted them."

Redwood was frequently used as ballast in home-going ships. A specific case is recorded in the Diary for 1682:—"Captain Willshaw of the Resolution complained that he would not be able to ride out yᵉ storm without sufficient Quintelage [ballast] therefor ordered that the warehousekeeper doe lade on board him 100: Tonns saltpetre and what Calliature wood can be got to stiffen his ship and inable him the better to ride out yᵉ storm."

In 1683 the Governor found it necessary to define the terms of freight with Captain Willshaw, a skipper of somewhat independent character. On January 1 the following official letter was sent to him:—"Wee do likewise acquaint you concerning Redwood or Calliature wood that (provided you are fully laden) except you are contented to receive but half freight for it wee shall not lade any upon your ship wee being ordered to send none home upon any other terms than that to which wee desire your answer that accordingly wee may lade or not lade the same upon you." Willshaw replied:—"As to the other particulars of the redwood I shall be willing to take it in for £9 10 p̄ Tunne being the ½ freight of Grosse goods provided that according to contract your worᵖ may have men aboard to saw and split it to which if yoʳ worᵖ and Councell will not condescend I am as ready to deliver both the petre and wood as I was willing to request the Lading it on board for the securitie of his Maᵗⁱᵉˢ subjects and the Companys concern therefore desire to know your Resolution till when none of the Petre or wood shall be stowed away but what is already stowed."

During the years 1683 and 1684 various payments were ordered to be made to the redwood merchants for the Honble. Company's account, and orders were regularly issued to the warehousemen to load the wood on English ships in the harbour. In order to maintain the supply in Madras, "Generalls" or letters were addressed to the northern factories in Vizagapatam and Masulipatam with requisitions for the wood to be sent down in coasting vessels.

In 1685 as much as 1337 pagodas were paid to the local redwood merchants in seven instalments during the year. Calculating the pagoda at 9*s*., this amounts to 605*l*. This, however, indicates only a portion of the trade for the year.

Reference to "The Private Diary of Ananda Ranga Pillai from 1736 to 1761" proves that the trade in red-sanders wood was still brisk. In 1743 the ship *Fleury* sailed for France with 1000 candies (candy = 500 lb.) and the *Phénix* with 2000 candies of redwood. It might be mentioned that the *James and Mary*, that gave its name to the dreaded sandbank in the Hooghly, and was wrecked on September 24, 1694, carried a cargo of redwood taken up at Madras.

In the "Letters received by the East India Company

from its Servant in the East, 1602–1617," there are numerous references to the various kinds of sanders wood, but they are easily distinguished. The red sanders wood always came from the Madras coast, and was sent to Europe for dyeing purposes. The white sandal wood (*Santalum album*) was used as a perfume, for medicinal baths, and for presents. Sappan wood, sapang, patanga, or Brazil wood came from Malaya and Siam from the tree called *Caesalpinia sappan*. It was one of the "vendiblest" commodities in the trade between Siam and Japan in 1615.

There is still a demand for red sanders wood, but the drug is not of so much importance as it was years ago. The reasons are well known—on account of the artificial substitutes now employed for dyeing purposes. Evidence of this is seen in the last issue of a Madras newspaper just to hand. It describes the visit of the Governor of Madras to a large modern cotton mill. One sentence reads:—"His excellency passed on to the reeling room and then to the dye house, where the dyes used are mostly aniline dyes." DAVID HOOPER.

Indian Museum, Calcutta.

Anguillula glutinis—Paste Eels.

IN Carpenter's work on the microscope, the eighth edition, so ably edited by the late Dr. Dallinger, occurs the following passage (p. 945): "This last [*A. glutinis*] frequently makes its appearance spontaneously in the midst of paste that is turning sour; but the best means of securing a supply for any occasion consists in allowing a portion of any mass of paste in which they may present themselves to dry up and then laying this by so long as it may not be wanted, to introduce it into a mass of fresh paste, which, if kept warm and moist, will be found after a few days to swarm with these curious little creatures."

As he also says that "a writhing mass of any of these species of 'eels,' is one of the most curious spectacles which the microscopist can exhibit to the unscientific observer," very many young microscopists have been led to try to obtain the eels by allowing paste to stand until sour, and also by getting dried paste known at one time to have contained "eels." Unfortunately, in this country at least so far as I know, such attempts have always failed, and I have received many letters asking for the cause of such failure.

Of course, it is generally acknowledged that no animals of the grade of these nematoid worms ever appear *spontaneously;* they were probably present in the water used to dilute the paste, but in paste that has been boiled and diluted with water that has been boiled they never appear, and I have tried hundreds, perhaps thousands, of experiments in this direction. And even when cold water from a pond or brook was used to dilute the paste, I never found them.

In regard to dried paste also, my experience has been different from that of Dr. Carpenter. When paste has been thoroughly dried in the open air in our climate, no eels can be made to appear by transferring some of this paste to fresh material and keeping it warm and moist. Paste may dry up to a stiff mass and the eels still live, but I have never been able to keep paste in a thin layer exposed to the air in our dry climate for one month and then resuscitate the eels. I have tried it over and over again, and the eels always disappeared. By keeping the paste slightly moist, however, the eels (or their progeny) may be kept indefinitely.

The fact that Carpenter could keep them alive after the paste had apparently dried up, may perhaps have been due to the moistness of the English climate in comparison with ours.

Fortunately, the "eels" may be found in most bookbinder's paste tubs, and a sufficient amount for a start may, if properly packed, be sent by mail provided the time of transit is not more than two weeks. JOHN PHIN.

Paterson, N.J., U.S.A.

The Fox and the Fleas.

THE story of the fox and the fleas, published in NATURE of March 23, is not current among Celtic people only. As Bohemia is a country full of fields, pastures, ponds, brooks, and forests, the last often being inhabited by foxes, it is no wonder that my father, who was a close observer of nature, told me the same story nearly fifty years ago. But the Bohemian fox was in one point distinguished from the English fox, for, being unable to find sheep-wool and probably not trusting to hay, and yet wishing to get rid of the fleas, he was obliged to sacrifice his own fur, and so he plucked out as much of his own wool or hair with his teeth as might easily serve to collect the fleas; and the effect was superior, for the fleas could creep into the hair without noticing any change of medium during the water trick.

As regards the question about the origin of the fleas, raised by Prof. Hughes in NATURE of April 13, my experience as an old hunter is that, at least in our comparatively dry climate, the animals living in forests have an ample opportunity of gathering fleas there. If you happen to shoot a squirrel, never put it into your bag or pocket, or else in a few minutes you will be swarming with fleas which are quickly leaving the dead animal.

Once I placed a freshly shot squirrel on a newspaper, and was surprised to find what an enormous quantity of little fleas of a peculiar kind (all these different kinds of fleas were studied by Baron Rothschild) were leaving the dead animal; and yet the squirrel lives more in the trees than on the ground, and hardly approaches stables or inhabited buildings; how much more easily can a fox collect his parasites on the ground of the forest!

Some readers of NATURE may ask what means the crayfish on the immersed tail of the left-hand side fox in the interesting figure on p. 211. To this I found an answer in the invaluable book on "Animal Intelligence" by Romanes, p. 432, according to which "Olaus witnessed the fact of a fox dropping his tail among the rocks on the *sea* shore to catch the *crabs* below, and hauling up and devouring such as laid hold of it." On the contrary, it is not clear what is the matter with the tail of the right-hand fox in the figure.

I may add that while ski-ing in deep winter in the Bohemian Forest I often watched the footsteps of different wild game in the snow, and once I found a trace of a fox without being able to tell which way he was going. After having followed it for about half a mile to the summit of a mountain, I found that the fox made a turn there and walked a long way back exactly in his own footsteps. Did he intend to conceal in which direction he was going? That the fox has sometimes this intention is shown by the fact that in the proximity of inhabited places the footsteps of the fox in the snow suddenly disappear, the fox having effaced them by his tail.

BOHUSLAV BRAUNER.

Bohemian University, Prague, April 21.

Belladonna Plaister for Bee-Stings.

SOME years ago it occurred to me to try the experiment of treating bee-stings with belladonna plaister; and, as this remedy is remarkably efficacious, and as I have met no one who was aware of the cure, I have intended for a long time to ask you to put the fact on record in your columns. If the sting is but slight, there are no unpleasant effects at all when belladonna is at once applied, and the plaister may be removed after a comparatively short time; if the sting is severe—*i.e.*, as I suppose, if it has entered a vein—it may be necessary to retain the plaister for several days; and in such case, although there will be swelling and some irritation, both these unpleasant effects will be very notably less than in cases where no belladonna has been used. Of course, as some people are extremely susceptible to bee-poison, it is quite possible that they may not find a belladonna-treated sting so small a matter as I find it; but I presume that they will find at least a proportionate alleviation. In the summer-time my children run about the garden bare-footed, and not unfrequently they step upon a bee and get stung. At once there is a shout for "belladonna"; it is put on; and we never hear another word about the sting. I have also found belladonna give great relief from a wasp-sting. I should be very glad to hear the result if anyone living in a "mosquito"-ridden part of the country would try the experiment of applying belladonna to mosquito-bites. It might well be quite useless; but, on the other hand, it might serve.

FRANK H. PERRYCOSTE.

Higher Shute Cottage, Polperro, R.S.O., Cornwall.
April 25, 1911.

THE TOTAL SOLAR ECLIPSE, APRIL 28, 1911.

NEWS of the results of this eclipse arrived in England from Vavau on Saturday afternoon, April 29, in the form of a cable through Reuter's Agency from Mr. P. Baracchi, Government astronomer at Melbourne, Australia. He reported that the observations of the eclipse were considerably interfered with by passing clouds, and that the results were only partially successful.

No news regarding the experience of the English parties observing at Vavau was available until Sunday morning, April 30, when Sir Norman Lockyer received a cable from Dr. Lockyer, sent by wireless from H.M.S. *Encounter*, at Vavau, to H.M.S. *Pegasus*, at Auckland, thence by cable, stating that the expedition from the Solar Physics Observatory had not been successful, in consequence of bad weather. With regard to the two most important spectroscopic instruments—a 6-inch prismatic camera with four large objective prisms of 45° angle, and a concave grating spectrograph of 10 feet radius of curvature—poor results have been secured by the first; photographs of the corona, with the two large coronagraphs of 16 feet and 8 feet focal length, were obtained, but of inferior quality.

A general description is given of the visual observations made of the form of the corona, from which we learn that it was of the typical minimum type, with long equatorial extensions. The general description of the eclipse is that it was not a dark one, and in consequence comparatively few stars were observed during totality.

The second English party under Father Cortie has been also unfortunate, but as yet no news is to hand regarding the experience of the German and American astronomers who proposed to occupy one or more of the islands to the north-east of Vavau.

In an interesting letter received from Dr. Lockyer he emphasises the generous and enthusiastic help afforded to the expedition by the Australian authorities. Mr. H. A. Hunt, the Commonwealth Meteorologist, at the request of the Government, invited Dr. Lockyer to inspect the site of the new Solar Physics Observatory, which is to be established near the new capital; this is a little more than twelve hours' railway journey from Sydney. It will be the only southern observatory having solar observations as its prime duty, and it fills a longitude gap between India and the United States. It is therefore anticipated that the results from such a locality will be of the greatest importance.

Towards the end of March the heavy equipment taken out from England was safely stored on board H.M.S. *Encounter*, of the Australian squadron, and the official party, in company with that of Father Cortie and Mr. Baracchi, sailed from Sydney on March 25, reaching Vavau on April 2. On the way arrangements would have been made for the organisation of the various parties, taking charge of each section of observation. Captain Colomb, R.N., assisted the expedition in every way, and from a telegram received last week we learned that on the call for volunteers more than 100 of the ship's company signified their willingness to take part in the observations. Parties would be formed for sketching the corona, observations of shadow bands, landscape colours, aids for the working of each of the large instruments, timekeepers, &c. By means of pictures of rmer eclipses which have been successfully observed and general descriptions by the astronomers in charge, all the members of these different sections would soon be rendered conversant with their individual duties. On landing steps would first be taken to select the most suitable site; then the ground would be roughly surveyed, and the positions selected for the pillars of the large instruments. This done, more accurate observations of the meridian line would be made, so that each instrument could be adjusted exactly in the proper orientation. When the instruments were satisfactorily installed and protected, periodical drills would be instituted, when all the operations, down to the smallest detail, would be practised, exactly as if the eclipse were really taking place. After two or three of these drills everyone becomes very proficient in their duty, and it is only such unavoidable misfortune as has attended the present occasion which can prevent good observations from being secured.

The latest information is that a second message has been received from Mr. Baracchi stating that some of the results of the Australian party are better than was at first anticipated. Thirty pictures of the corona have been obtained. CHARLES P. BUTLER.

STANDARD BREAD.

ALMOST every people boasting the rudiments of agriculture makes use of cereals as part of its food. The cereals comprise all grains or corn-bearing plants, and are grasses which by long cultivation and selection have developed a maximum of food material with a minimum of husk. Wheat, barley, oats, rye, maize, millet, and rice are the principal cereals, and the first four have an extraordinarily wide geographical distribution. The following is the average composition of cereals:—

	Per cent.
Proteins	10–12
Carbohydrates...	65–75
Fat	0·5–8
Mineral salts	2
Water	10–12

Maize and oats are the richest in fat, wheat and rye contain respectively 1·7 and 2·3 per cent. of fat, while rice contains the maximum of carbohydrate and the minimum of protein and fat. Regarded as a diet the cereals contain a large excess of carbohydrate and a deficiency of protein and fat. Wheat and rye are alone suitable for bread-making; this is due to the fact that they contain a peculiar protein "glutin," which becomes viscid when mixed with water, and determines the binding properties of the dough. Glutin does not exist as such in the grain or flour, but is developed by the interaction in the presence of water of two proteins, gliadin and glutinin.

For the preparation of flour the grain is ground or milled, and in the process, which by means of

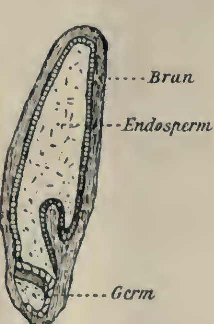


FIG. 1.—Diagram of structure of wheat grain.

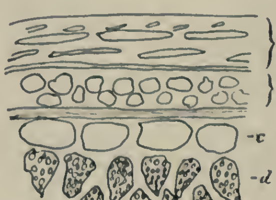


FIG. 2.—Diagram of layers of wheat grain.

modern machinery in the iron roller mills has been brought to an extraordinary degree of perfection, various constituents of the grain are

separated. A grain of wheat consists of (1) an outer envelope or husk, which constitutes the bran, (2) the kernel or endosperm, and (3) the germ (see Fig. 1). The husk has an outer cuticle from which delicate hairs spring (Fig. 3), under which are three other layers, the two outer consisting of elongated cells (Fig. 2, *a*), the third of well-defined rounded cells (Fig. 2, *b*). Then comes the envelope of the seed proper, the "testa" or "episperm," under which is a layer of large quadrilateral "cerealin" cells (Fig. 2, *c*), which encloses the endosperm; the latter consists of numbers of large cells with delicate walls filled with starch granules (Fig. 2, *d*). The husk, constituting the bran, consists mainly of cellulose with pigment and

Fig. 3.—Outer cuticle with hairs of grain.

Fig. 4.—Inner skin or epicarp of grain.

mineral salts, the endosperm consists largely of starch, and the germ, relatively a small portion of the whole, is rich in protein and fat. In the process of milling the grain is broken up and various "mill products" are obtained. The outer coats yield bran, fine pollards, sharps, and middlings, the germ is removed as offal, while ordinary flour is derived almost solely from the endosperm. The flour itself is divided into a larger portion, "bakers" or "households," and a smaller, very white and poor in protein, known as "patents," from which genuine Vienna bread and the best class of fancy breads and pastries are made. The semolina, derived from the central part of hard wheat, and rich in glutin, is also lacking in white flour.

It will thus be seen that ordinary white flour and white bread made therefrom contain little or none of the bran, germ, and semolina, and valuable food con-

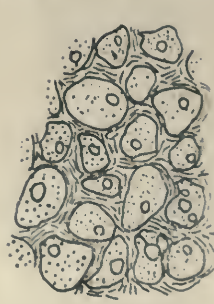


Fig. 5.—Large-celled endocarp layer of grain.

stituents—mineral matter and protein of the bran and semolina, and fat and protein of the germ—are lost. Wholemeal bread is therefore richer in the nutritive constituents and has more flavour, but is darker in colour than white bread, owing partly to the inclusion of the bran and partly to an interaction by which dextrin and sugar are formed which undergo darkening in the oven. Wholemeal bread is, however, apt to be irritating on account of the cellulose and silica of the outer coat, but by removal of the outer layers of the husk the irritant material may be excluded, and the valuable mineral, protein, and fatty constituents of the inner branny coat, semolina, and germ, are retained. Such a flour constitutes the "80 per cent. flour" employed in making the so-called "standard" bread. The term "80 per cent. flour" means that a wheat a bushel of which weighs 64 lb. yields 80 per cent. flour. In the old method of milling the wheat is ground between stones, the flour being separated by sifting, and in this way some of the "offal" is retained; hence the term "stone-ground."

"Standard" bread is distinctly cream-coloured, and contains pale brown particles derived from the branny coats of the grain. It has more flavour and is moister than ordinary white bread, and contains more phosphates and other mineral salts. Microscopically various branny constituents can be recognised, *e.g.* cuticle with hairs (Fig. 3), inner skin or epicarp (Fig. 4), and large-celled endocarp layer (Fig. 5), and these figures are reproduced from actual drawings of a sample of "Standard" bread examined. There is doubtless some difference of opinion as to the relative values of ordinary and "Standard" flour, and the bread made therefrom. The roller mills cleanse the wheat in a very efficient manner. Chemical analysis, except as regards salts, shows little difference between the two; "standard" bread may even be slightly poorer than ordinary bread in protein, owing to the greater percentage of moisture. On the whole, however, we think there can be little doubt that "Standard" flour and bread are to be preferred. Their use will also tend to revive wheat growing and the small miller in England.

THE HOME LIFE OF THE SHANS.[1]

THE Shan States under the control of the Government of Burma form two groups, the northern and the southern, separated for some distance by the Nam Tu or Myitnge River in the eastern portion of the province. Ethnologically, the Shans are a branch of the great Tai people, "the free," who at present exercise sovereignty only in Siam. The affinities of the branches of this people are obscured by the bewildering variety of names which disguises their identity, while the dialects are mutually incomprehensible, and, as if this were not enough, are recorded in at least six forms of written character. Even the origin of the name Shan is a puzzle, the only reasonable explanation being that of Sir J. G. Scott, who points out that they were known to the Burmese as Tarok or Taret, and possibly gained their present title from their Chinese designation, Han Jen. Our knowledge of them is derived from the accounts of earlier travellers like Dr. Richardson, Captain Macleod, and Sir H. Yule; from the translation of tribal chronicles by Mr. Ney Elias and Sir J. G. Scott, and of Chinese authorities by Mr. G. H. Parker; and, in particular, from the monograph on their history and ethnography written for the Census Report of Burma, 1892, by Dr. J. N. Cushing. In the present book the information thus collected has been carefully summarised in two chapters on tribal history and literature by Mr. W. W. Cochrane.

Mrs. Leslie Milne spent about twenty months in a Shan village with the object of studying the language of the Palaung or Palê, a neighbouring hill tribe who

[1] "Shans at Home." By Mrs. L. Milne. With Two Chapters on Shan History and Literature by the Rev. W. W. Cochrane. Pp. xxiv+289. (London: J. Murray, 1910.) Price 15s. net.

trade with the Shans, but are allied to them neither by race nor language. She is a careful and sympathetic observer, and has profited by information received from the officials of the American Mission. At the same time, she has not avoided that almost idyllic conception of their character and beliefs which is prominent in the accounts of Burman life and psychology by enthusiasts like Sir J. G. Scott and Mr. Hall Fielding. The truth is that their views are largely based upon the obvious contrast between the races of Burma and those of the Indian plains. While the latter, mainly owing to the bondage of the caste system, are reticent, suspicious, and unwilling to associate with the foreigner, the former are cheerful, kindly, and beset by none of those taboos of food and personal pollution which in India proper form an effective barrier between the people and their rulers.

FIG. 1.—Circles of sand made by Shans in shallow parts of muddy streams, in order to act as water filters. From "Shans at Home."

Such views naturally lead to exaggeration. In the case of religious beliefs, for instance, Mrs. Milne has failed to grasp the fact that their beliefs are almost purely animistic, and that Buddhism is only a thin veneer concealing the predominant workship of Nats or spirits. It is true, as she observes, that among them "there is no great fear of death; they all feel that they have all lived and died so often that death and its mystery is not talked of in a whisper, but is a favourite topic of discussion in Shan houses." "They place," she goes on to say, "religion and the study of their scriptures, and a temperate life on a higher level than money or the comforts and luxuries that money brings. Their lives are very happy. Any man may marry the girl he loves if he can persuade her that she loves him better than any other man. There is always money enough, and food for the children that come to gladden their homes. Starving people do not exist, and there are few unemployed, because any man or woman may easily earn a livelihood by asking for jungle land, by clearing and cultivating, and by selling the produce that is grown upon it." When British rule was introduced

FIG. 2.—Market Day. From "Shans at Home."

we found them harassed by raids of the neighbouring Kachins and torn by internecine war. Now they are clamouring for roads which will enable them to bring their produce to the railway. It will be interesting to watch how long this almost idyllic social state remains unaffected by the pressure of commercialism.

Mrs. Milne's account of their home life and industries is clear and comprehensive; and the value of her book is increased by an excellent collection of photographs. It is certain to survive as the standard account of a most interesting people recorded at a time when they were little affected by external influences.

BELGIUM'S CONTRIBUTION TO THE PLAICE PROBLEM.[1]

THE plaice problem still occupies a prominent position in the foreground of the international investigations. The reason is not that the plaice is the sea-fish which contributes most wealth to the countries concerned. In respect of total value landed the fish is surpassed in England by the haddock, the herring, and the cod, while in Belgium the total value of soles annually landed is more than twice that of plaice, which stands fourth in the list, after haddock and herring.

The reasons why the plaice is of such importance that it has been made the principal object of investigation on the parts of England, Germany, Denmark, Holland, and Belgium are as follows:—

(1) This fish constitutes a proportionately large as well as much appreciated element in the ordinary dietary of the poorer classes in the five countries named.

(2) The livelihood of large numbers of fishermen in these countries depend on their ability to maintain an adequate supply of this fish in the markets.

(3) It is especially in regard to the plaice that the cry of "depletion" of the fishing grounds, and of the undue destruction of undersized and immature fish, has been, and is still being, raised.

(4) The plaice lends itself perhaps more readily than any other fish to protective legislation, on account of its comparatively restricted range, its regular distribution from the coast seawards according to size, and its slow rate of growth.

In view then of the urgent need which was expressed in discussions on the plaice at Royal Commissions and fishery conferences of a satisfactory knowledge of the natural history of the fish on one hand, and for trustworthy statistics showing the actual condition of the fishery in time and space on the other, it is not surprising that the International Council took the matter in hand at the outset of its career and arranged for a thorough investigation of the plaice fisheries both from the biological and from the economic point of view, an investigation in which each of the five countries most interested was appointed a share. The result of the large amount of research which has been expended on the plaice during the past few years is that we now possess a considerable amount of information respecting the movements of the fish at all stages of its career, the age of the fishes, and their growth-rate in different parts of the sea, their age and size at maturity, and so forth, while the sea fishery statistics of the various countries bordering on the North Sea have been so completely reorganised that they now show us, for a quinquennial period at least, something like the actual yield of different fishing grounds from year to year and from month to month.

Although we have no continuous or sufficiently exact statistics of the plaice fishery extending into last century, there can be no reasonable doubt that the condition of the fishery and the composition of the plaice population on the fishing grounds are very different to-day from what they have been in the memory of the older fishermen, and fragmentary statistics of the number of baskets formerly taken are not altogether wanting to show this. If the destruction of an "accumulated stock" of old fishes (such as is to be found in the Barents Sea at the present day, and not so many years ago at Iceland) was inevitable, and quite rational and economic, the same can scarcely be said if the supply of fish at the present day is being maintained at the sacrifice of an increasing proportion of the smaller and much less valuable sizes. If this actually is the trend of the fishery at the present day, then, apart from the possibility of an ultimate shortage of supply which is at any rate threatened, it is obvious that the fishery is not being exploited in a rational way. As Prof. Gilson, in his important memoir, says:—"On sait qu'il faut considérer la capture en grande masse de jeunes plies, inaptes à la reproduction pour la plupart et *capable de gagner en une année le double et même le triple de leur valeur*, comme une opération antiéconomique appelant une reforme."

It is greatly to the credit of Prof. Gustav Gilson, of Louvain, the Belgian delegate to the International Council, that he has been able to carry out a plan of researches in accordance with the international programme, in spite of the great disadvantages attending the lack of a special research steamer able to work on the fishing grounds at all seasons, and of a coastal laboratory where material could be examined fresh and continuously.

The institution in Belgium which has assumed the task of participating in the international investigations is the Royal Museum of Natural History, which maintains a station for sea fishery research at Ostend. Solely with the aid of the resources of this institution and entirely outside the official machinery, Prof. Gilson has reorganised the sea-fishery statistics at Ostend. Previous to 1904 these gave only the total quantities and value of fish landed at the port without distinction of species, size, number of baskets or fishes, place of capture, &c. From 1904 onwards, thanks to Prof. Gilson's efforts, all these and other essential particulars are given in the statistical returns, so that now the Belgian statistics are equally precise and detailed as those of other countries bordering the North Sea.

In the memoir under review the data collected with regard to the plaice landed at Ostend are analysed and coordinated from two points of views:—(1) So as to show the principal features in the evolution of the Belgian plaice fishery during the quinquennial period (1904–8), and (2) to furnish indications of the influence which a raising of the minimal size legally established (18 centimetres) would probably exercise on one hand on the reserves of plaice in the sea, and, on the other, on the product of the fishing industry in weight and value.

It is impossible to indicate all the features in the evolution of the Belgian plaice fishery during the period 1904 to 1908 which are revealed by Prof. Gilson's analysis of the Ostend statistics. It will suffice to point out the most important feature from the point of view of the present discussion. This is to be found in the progressive increase from year to year of the proportion of small fish in the catches of the *sailing* trawlers, which boats are re-

[1] Contribution à l'Etude biologique et économique de la Plie. Par G. Gilson. Délégué de la Belgique au Conseil international pour l'exploration de la mer. Travaux de la Station de Recherches relatives à la Pêche maritime. Ostende. Fascicule IV. (Bruxelles: Imprimerie Polleunis et Ceuterick, 1910.)

sponsible for the great bulk of the plaice landed at Ostend at the present day. Now it is clearly shown that this increase in the proportion of small fish is not due to a change in the field of action of the boats concerned, for the displacement which has actually occurred has been of such a nature that it ought to have produced a *contrary* effect. It is in consequence of a modification of the composition of the reserves of plaice inhabiting the Southern Bight of the North Sea. The curves for the various divisions of the Southern North Sea show this very clearly. The proportion of small fish in the annual catches in *each* of these divisions shows a gradual rise from 1904 to 1908. That the change in the composition of the plaice population on these fishing grounds consists in a diminution in the number of large individuals and *not* in an increase in the number of small is also fairly clear.

This is the important point: the supply of plaice in the Belgian market is apparently being maintained at the sacrifice of an increasing proportion of the smaller and much less valuable sizes. Researches on similar lines which have been made by the other four nations most interested have apparently much the same tale to tell; but, as these have not been co-ordinated and compared, it would be premature to make any general statement about the condition of the plaice fishery in the North Sea as a whole.

As a remedy for the state of things revealed in the Belgian statistics, Prof. Gilson suggests the *tentative* imposition of a minimum size of 23 centimetres, below which it should be illegal on the part of the sailing trawlers to land or sell fish, and a similar standard of 25 centimetres for steam trawlers. The reasons for the selection of these particular size limits and for a distinction between the two classes of vessels in this respect are fully discussed in the report and hardly need be recapitulated. Very similar size limits for plaice have been suggested by certain of Prof. Gilson's colleagues on the International Council, who will probably be found unanimous in agreeing with him that all such measures designed for the protection of undersized plaice should be of an experimental and elastic nature. In view of the still very incomplete state of our knowledge of the plaice problem, which is far more complex than was at first supposed, certainly no State would be justified in making such legislation final or irrevocable. It would be impossible to predict the effect of the imposition of a given size limit, or the amount of inconvenience attending its enforcement. It is inevitably a case of "try and see." Moreover, a size limit is not the *only* possible means of bettering the plaice fishery. Transplantation to the Dogger Bank, and other grounds richer in food, has been tried on an experimental scale with striking results, in view of which it is worth considering as a possible commercial enterprise.

Finally, one cannot but agree with Prof. Gilson that if we are ever to have experimental legislation for plaice, then it is clear that the scientific control of its effects is indispensable. In other words, there ought to be a permanent International Commission to continue researches on points not yet elucidated, to study the statistics from year to year, and to carry out biological investigations designed to show the changes in the composition of the plaice population on the fishing grounds and in the rate of growth of the fishes which might be expected to result from the legislation. As Prof. Gilson truly says:—"C'est à ce prix seulement que l'on peut espérer de réparer le mal accompli et de porter remède à la rupture encore récente de l'équilibre qui s'était établi, au cours des siècles, entre la puissance alimentaire des mers, le pouvoir reproducteur des espèces et les causes de destruction aux quelles celles-ci étaient soumises avant l'intervention de l'homme."

WILLIAM WALLACE.

NOTES.

MR. A. E. SHIPLEY, F.R.S., has been elected a foreign corresponding member of the Helminthological Society of Washington.

WE regret to announce the death, on April 15, at seventy-nine years of age, of Prof. J. Bosscha, correspondant of the physics section of the Paris Academy of Sciences, and formerly permanent secretary of the Dutch Society of Sciences at Haarlem.

THE National Geographical Society of America is sending out in the summer an expedition for the further study of the glaciers of Alaska. It will be led by Prof. Ralph S. Tarr, of Cornell University, and Prof. Martin, of the University of Wisconsin.

AN expedition, under the charge of Prof. Homer R. Dill, taxidermist of the University of Iowa, has left San Francisco for Layson Island. This island, which is situated in the Pacific about midway between California and Japan, is only about three and a half square miles in area, but is estimated to support a bird population of about eight millions.

THE tenth International Congress of Geography will be held at Rome on October 15 and the six following days. Excursions in northern and central Italy, as well as southern Italy and Sicily, will be arranged, of which the details will be published later. The subscription for membership of the congress is *1l.*, and all persons desirous of joining are requested to remit this sum at an early date to the treasurer of the committee, 102 Via del Plebescito, Rome.

THE Victoria League has in operation a scheme for sending newspapers and magazines, when done with, to addresses in distant parts of the Empire. Although more than 81,000 newspapers and magazines are being sent away annually there are still many applicants unprovided for, and in South Africa and Victoria, Australia, particularly, we are informed copies of NATURE would be gratefully received. Any reader willing to help the movement should apply to the hon. sec. of the Newspaper Scheme, 2 Millbank House, Wood Street, Westminster, S.W.

PROF. HANS MEYER will undertake in May his fourth journey in East Africa. Starting from Bukoba, on the west shore of Lake Victoria, he proposes to march to Lake Kiva and the Kirunga group of volcanoes, in order to study the relations of the volcanic phenomena to the tectonic structure of the western rift system at this point. From Kiva the expedition will travel by Lake Tanganyika and, if time permits, also to Lake Nyassa. Besides geological studies, the botany, zoology, and ethnology of the region traversed will also be investigated.

DR. PÖCK, in the April number of *Petermann's Mitteilungen*, discusses the distribution of plague during recent years, and illustrates it by two maps. The first shows the location of areas where it is endemic, and also those over which it has recently spread, as well as the places where isolated cases have occurred in different years. The second map shows the probable area of origin of the recent outbreak in Manchuria, and the region which was affected.

The influence of modern facilities of communication on the spread of the disease is insisted upon as constituting a factor acting against and sometimes having greater effect than the resources of modern sanitary science in some regions.

At a meeting of the Research Department of the Royal Geographical Society on April 27, Mr. A. R. Hinks discussed recent progress in geodesy. Invar tapes and wires have revolutionised base measurement; gravity surveys have been carried out over large areas, while abnormalities of gravity in more restricted regions have been determined with remarkable accuracy by the torsion balance; arcs of meridian have recently been measured in Spitsbergen, Africa, and Peru. In view of so much activity in geodetic work, it is to be regretted that so little has been done of late years in the United Kingdom. The measurement of an arc of meridian and a detailed gravity survey were instanced as pieces of work which should be carried out in these islands, and discussion on these matters was invited.

A Reuter message from Sydney states that the schooner *Kainan Maru*, the ship of the Japanese Antarctic Expedition, arrived there on April 30, the object of the expedition having been abandoned. The vessel, which left New Zealand in February for the Antarctic continent, was obliged to turn back on account of the ice packs and icebergs which she encountered, and reached Coulman Island, off the coast of Victoria Land. The decision of the explorers to abandon the attempt to reach the Pole was also influenced by the fact that ten of the twelve Eskimo dogs which were to have been used to pull the sledges succumbed to the cold. After cruising in the vicinity of Coulman Island for four days, the *Kainan Maru* set out for Sydney. A Reuter message from Hamburg reports that preparations are complete for the departure of the German Antarctic Expedition on May 3 on board the 598-ton barque *Deutschland*. The vessel will go first to Bremerhaven, whence she will start for Buenos Aires on May 7.

We regret to announce the death, on April 28, in his fifty-third year, of Dr. J. Tatham Thompson, the well-known ophthalmic surgeon of Cardiff. He had suffered for many months from a painful and incurable illness. Dr. Thompson was born at York, educated at Bootham School in that city, and received his medical training at the University of Edinburgh, where he had a distinguished career and graduated M.B., C.M., in the year 1885. For some time he acted as assistant to the late Dr. Argyll Robertson, of the Edinburgh Royal Infirmary, and afterwards he obtained the appointment of ophthalmic surgeon to the Edinburgh Western Dispensary. During his stay in Edinburgh, he was distinguished by his artistic abilities, and many of the drawings in Berry's "Diseases of the Eye" were from his clever pencil. Dr. Thompson, however, soon went to South Wales, where he obtained the appointment of ophthalmic surgeon to the Cardiff Infirmary, which he held for many years. During this time his pen was seldom idle. He found time to write upon many ophthalmic subjects, including the influence of school life upon eyesight, nystagmus among Welsh miners, and the removal of foreign bodies from the interior of the eye by the aid of the magnet. At the time of his death Dr. Thompson was one of the vice-presidents of the Ophthalmological Society of the United Kingdom.

The death is announced of Dr. F. J. C. Terby, who worked long and assiduously to promote astronomical science. In a private observatory, which he constructed at Louvain, he mounted a Grubb equatorial of 8 inches aperture, and employed it mainly and usefully in the study of the surface markings of the planets. Mars particularly interested him, and he made a careful discussion of the physical features of this planet, recorded from the time of Fontana. This is a very valuable contribution to observational history. It puts into the hands of astronomers an accurate and ready summary of a great amount of detailed information, acquired by industry and sifted with intelligence. His observations of Venus appear to have been accurate and systematic, supporting Schiaparelli's view of the coincidence of the period of rotation with that of revolution. As an amateur astronomer, comets naturally attracted his attention, and the record of his observations of the physical features of many will be found in the pages of the Memoirs of the Royal Academy of Belgium and in the Bulletins. Of late years his observations appear to have been less frequent, probably on account of ill-health, but for many years he worked zealously, and his memory should be treasured as of one who laboured to inspire others with enthusiasm, and to make the science of astronomy respected.

The Times records the death of Mr. Henry Scherren, at his residence in Cavendish Road, Harringay, on April 25. Mr. Scherren had been a Carthusian monk, but abandoned his orders in the year 1878, and subsequently resided in London, where he devoted himself to journalism, more especially in regard to its natural history side. One of his favourite subjects was the zoological gardens of Europe, on which he wrote many articles, the last appearing in *The Field* of April 29, after his death. He also wrote an interesting history of the Zoological Society of London, of which he was elected a fellow in 1889. Among his contributions to zoology may be mentioned an account of the early history of Grèvy's zebra, and another of the giraffe presented to King George IV. Mr. Scherren was born at Weymouth in 1842, and educated at the Romanist College at Mill Hill. For a period of twenty years he was in the employ of Messrs. Cassell, during which he acted as sub-editor of their "Encyclopædic Dictionary." He also wrote for *The Leisure Hour* and other journals.

Three letters have recently appeared in *The Times* (April 24, 25, 27) relating to a mysterious heraldic animal known as the "jall" or "eall," of which the effigy has been recognised in St. George's Chapel, Westminster, on a stall-plate supporting the arms of John Duke of Somerset, 1440. Later, the jall appeared among the Sovereign's cognizances. Although described as having horns, tusks, and a short fluffy tail, the jall has been identified with the goat, but the Rev. H. F. Westlake, custodian of Westminster Abbey, adopts the view that it was "the" antelope. In an old document quoted by Mr. G. C. Druce, the eall is stated to be as large as a horse, with a tail like that of an elephant, goat-like jaws, and horns capable of movement, its colour being black. Other accounts state, however, that it has jaws like a wild boar and cloven hoofs. It may be suggested, if the beast ever had corporeal existence, that the African wart-hog may have formed the original type, that animal having a black hide, cloven hoofs, an elephant-like tail, large tusks, and big face-warts which might perhaps be regarded as elastic horns.

Much interest attaches to the description, by Mr. O. Thomas at the meeting of the Zoological Society on April 25, of a new form of takin from the Tsin-lin range of southern Shen-si, Central China. The typical Mishmi

takin (*Budorcas taxicolor*) is a dark-coloured animal with a large tawny area—traversed by a black spinal stripe—on the back. In the Sze-chuen takin (*B. tibetanus*) nearly the whole of the upper parts, exclusive of the face and ears, which are black, have become either golden-yellow or whitish-grey, and this tendency to the development of yellow culminates in the new Tsin-lin takin, in which all the black has disappeared, so that the whole fur, which is very long, is a beautiful golden-yellow. Mr. Thomas has named this takin *Budorcas bedfordi,* in honour of the Duke of Bedford, who is defraying the cost of the expedition which resulted in its acquisition. Whether the three forms are regarded as distinct species or as colour phases of one species, they are of great interest as showing the evolution of a golden from a black and chocolate type of colouring. What renders this the more remarkable is the fact that a similar development occurs in the case of the snub-nosed monkeys (Rhinopithecus), in which the comparatively low Mekon species is slate-coloured, while the elevated Sze-chuen form is bright golden-yellow.

THE second Irish Road Congress, held in Dublin on April 19, 20, and 21, attracted a large attendance of members, most of whom were men actually engaged in the construction and maintenance of Irish roads. The work of the congress was divided into three sections, dealing respectively with the laws and procedure relating to road construction, statistics, &c.; road construction and maintenance; and modes of locomotion. Twenty-five papers were submitted, mainly of a practical nature; but the chief subject dealt with in the discussions was the treatment of Ireland by the newly constituted Road Board, the general opinion of the members finding expression in a unanimous resolution to the effect that, in allocating the funds at its disposal, the Board had not carried out the avowed intentions of the sponsors of the Development and Road Improvement Act in Parliament, viz. that the proceeds of the special taxes raised with this object would be distributed without reference to the sources from which the money was drawn. The address of the president, Mr. P. J. O'Neill, J.P., chairman, General Council of County Councils, was almost entirely confined to this aspect of the road question, and gave the key-note to the proceedings; but the discussions, in which Sir George Gibb, president of the Road Board, and Colonel Crompton, consulting engineer to that body, took part, also included subjects of practical importance, such as the testing of materials, direct labour as opposed to the contract system, and the effect of motor traffic on the roads.

AT a meeting of the Royal Dublin Society held on April 25, the Boyle medal of the society was presented to Prof. John Joly, F.R.S. A report upon his work was read by Dr. J. M. Purser, and some of the subjects mentioned in it are here summarised. Prof. Joly's researches deal with physics, geology, mineralogy, botany, and biological theory. In 1886 Joly published the method of condensation in calorimetry, and investigated the specific heats of minerals. He also determined the specific heats of gases at constant volume. By the meldometer he determined the fusion points of minerals, and showed the use of the instrument in carrying out reactions of pyrochemistry. He determined the volume change of rocks and minerals on fusion. He also invented the incandescent electric furnace. Joly advanced a physical theory on the origin of the canals of Mars, accounting for the linear markings on the planet. In 1896, he invented a method of colour-photography to reproduce with accuracy the colours of nature on a transparent plate. In 1898 he showed how the sodium content of the ocean could be used as a measure of geological time. The theory of sedimentation has also been advanced by his researches on electrolytic precipitation. By many researches he has laid the sciences of petrology and mineralogy under obligations to him. We would specially notice his invention of a polariser whereby the value of birefringence as a means of identification is increased, and his application of the microscope to the determination of the quality of paving-sets and road-metal. In connection with radioactivity, he has advanced our knowledge of the properties of radio-active substances. His explanation of Pleochroic Haloes in rocks as due to radioactivity leads to conclusions as to the non-existence of alpha-radiation from common elements. By the determination of the thorium content of rocks, he has established a mean value for its distribution in the surface-materials of the earth.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1910–11:—Telford gold medals to Mr. W. J. Wilgus (New York) and Mr. J. Walker Smith (Edinburgh); a George Stephenson gold medal to Mr. Philip Dawson (London); Telford premiums to Messrs. G. W. Humphreys (London), H. K. G. Bamber (Greenhithe), A. E. Carey (London), William Dawson (Crewe), and C. S. R. Palmer (London); and the Trevithick premium to Mr. A. T. Blackall (Reading).

AT the annual general meeting of the Institution of Civil Engineers, held on April 25, the result of the ballot for the election of officers was declared as follows:—*President,* Dr. W. C. Unwin (London); *vice-presidents,* Mr. R. Elliott-Cooper (London), Mr. A. G. Lyster (Liverpool), Mr. B. Hall-Blyth (Edinburgh), and Mr. J. Strain (Glasgow); *other members of council,* Mr. J. A. F. Aspinall (Liverpool), Mr. J. A. Brodie (Liverpool), Mr. W. B. Bryan (London), Colonel R. E. B. Crompton, C.B. (London), Mr. W. Davidson (Australasia), Mr. J. M. Dobson (London), Mr. H. F. Donaldson, C.B. (London), Mr. E. B. Ellington (London), Mr. Maurice Fitzmaurice, C.M.G. (London), Mr. J. P. Griffith (Ireland), Dr. C. A. Harrison (Newcastle-on-Tyne), Mr. W. Hunter (London), Mr. G. R. Jebb (Birmingham), Mr. H. E. Jones (London), Mr. E. H. Keating (Canada), Sir Wm. Thos. Lewis, Bart., K.C.V.O. (Aberdare), Sir Thomas Matthews (London), Mr. W. Henry Maw (London), Hon. C. A. Parsons, C.B. (Wylam-on-Tyne), Mr. F. E. Robertson, C.I.E. (London), Mr. Alexander Ross (London), Mr. J. W. Shores, C.M.G. (South Africa), Hon. F. J. E. Spring, C.I.E. (India), Sir Philip Watts, K.C.B. (London), Mr. W. B. Worthington (Derby), and Mr. A. F. Yarrow (Glasgow). This council will take office on the first Tuesday in November.

AMERICAN scholars are at present busily engaged in exploring the materials for the study of the history of their continent which are stored in the record-rooms of Europe. A useful contribution to this inquiry is the catalogue of the Italian documents, which has been prepared by Prof. C. R. Fish, and recently published by the Carnegie Institution of Washington. Students of the history of countries other than America will be interested in the descriptions of the manuscript collections at the Vatican, the Propaganda Fide, and other repositories at Rome, Naples, Venice, Turin, and Florence, with the conditions under which they are available for examination.

IN one of those comprehensive discussions of special anthropological problems, of which the French reviews hold an almost complete monopoly, M. B. P. Van der Voo in the April issue of *La Revue des Idées* examines the origin in the belief in metempsychosis. Finding its origin to lie in the same group of conceptions which include the

passage of the soul into animals and plants, he discusses in order the Indian evidence, the conception of the moon as the abode of spirits and the deity of life, its influence on the rain, and that of the rain on human life. He next deals with the various forms of reincarnation—in the Carnivora, snakes, birds, and, finally, in human beings. This essay, with its abundant references to the literature of the subject, must be of the greatest value to students.

The Ethnographic Survey of India, with a view to the preparation of revised editions of the accounts of the tribes and castes of Bengal, the United Provinces, and other parts of the Empire where the information has been tabulated, publishes occasional monographs on special subjects of interest. The most recent of these is an account of the marriage rites of the Prabhus of western India, who, like many castes engaged in literary pursuits, now claim to be of Kshatriya or warrior origin. The monograph, as Mr. Annandale remarks in his prefatory note, would be improved by compression; but it supplies abundant evidence of the predominating belief in the efficacy of magic to counteract the power of malignant spirits and the evil eye, which is the chief basis of the domestic rites of the Hindus. Its value for European readers would be much enhanced by a few photographs illustrating the arrangement of the marriage booth, the sacred fire, and the other appliances of the rites, which would assist students of the ceremony who have not enjoyed the chance of witnessing a high-caste marriage.

We have received a copy of the second report of the Jerusalem Society for the Prevention of Cruelty to Animals. In view of the ill-treatment to which domesticated animals are subjected in many parts of the East, the movement is well worthy of sympathy and support.

The second number of the Journal of the East Africa and Uganda Natural History Society contains a large amount of interesting matter relating to the fauna of our East African possessions, Mr. F. J. Jackson contributing a synopsis of the game-birds of the district, while Mr. C. W. Hobley discusses spitting cobras. For a long time naturalists were very shy in accepting the assertions of settlers that an African snake possesses the power of ejecting their venom to considerable distances. The statement has, however, of late years been verified by indisputable evidence, and Mr. Hobley has now been able to identify the species as the black-necked cobra (*Naia nigricollis*). Additional testimony as to the spitting power of these serpents is given by the author himself, who on one occasion in the Athi saw a dog put up a cobra from a bush. "It swayed its head slightly and gradually drew it back, and I expected any second to see it strike the dog, but, instead of that, a stream of colourless liquid shot out of its mouth into the dog's face, and the snake dropped and wriggled into the bush." The flashlight photograph by Mr. Cherry Kearton of a lion going to drink is unsurpassed.

Part v. of the Ceylon Marine Biological Reports is devoted to an account of the scientific work on the local pearl-banks during 1910, and in one section of the report Mr. T. Southwell discusses the present condition and future prospects of the banks. As these cover an area of more than 700 square miles, it will be obvious that the task of ascertaining their general condition—let alone any attempt at controlling the natural factors—is of stupendous difficulty. Furthermore, the Ceylon pearl-oyster has the sexes separate, instead of being, like the continental species, hermaphrodite, while it thrives best in the open sea at a depth of about 6 fathoms in place of in intertidal waters, consequently the system of culture which has been found to succeed in the case of the mainland species proved practically useless when applied to the Ceylon banks. At the present time these banks are almost unproductive; and it seems that there are periodical spells of barrenness, when not a single adult oyster is to be found over the whole area. During such a period the banks may, however, become suddenly replenished and covered in countless numbers with spat over several square miles, and the problem now awaiting solution is the origin of this presumably foreign spat. The second problem is connected with the disappearance of the oysters, both old and young. Although it has been proved that predaceous fish and boring molluscs have a share in the destruction, there still remains a considerable percentage of oysters which die for some reason at present unknown, although disease may be the cause. When these problems are solved, and measures taken to counteract the evil, hopes are entertained for the future of the beds.

In our issue of January 19, 1911, we gave a full account of the paper read by Dr. Johan Hjort before the Royal Geographical Society, describing the oceanographical expedition of the s.s. *Michael Sars* in the North Atlantic. The April number of *The Geographical Journal* contains the first instalment of the complete paper, which is illustrated by three excellent plates showing some of the deep-sea fishes which were captured by the expedition, as well as by a considerable number of text figures. The vertical distribution of the two fishes, *Cyclothone microdon* and *Cyclothone signata*, is clearly shown by a series of diagrams representing the numbers of fishes of different sizes captured at various depths down to 1500 meters. These results prove the value of the methods adopted by the expedition of making simultaneous hauls, lasting for a considerable time, at many different depths.

Dr. Johan Gehrke (Publ. de Circonstance, No. 52, Internat. Comm. Marine Invest.) gives an account of the hydrography of the Baltic, with details of the salinity, temperature, and oxygen content of the waters of different regions of that sea. Dr. Arwidsson (No. 54) records detailed observations on the mass, colour, reproductive organs, scales, and food of 148 examples of salmon (*Salmo salar*) from the river Laga, in south-west Sweden, and concludes that, in all probability, the fish go down this river to the sea for the first time in the spring following the completion of their second year.

Prof. Ermanno Giglio-Tos, formerly of the Royal University of Cagliari, has succeeded the late Prof. Giglioli in the chair of zoology, anatomy, and physiology of vertebrates in the Reale Istituto di Studi Superiori of Florence. His introductory address dealt with the subjects of organic evolution, natural selection, and the origin of species. He distinguishes somatic variations of two kinds:—(1) somatogenous, produced by the environment, and not giving rise to modifications in the germ, and therefore of no importance in regard to the origin of species (*e.g.* in Artemia); (2) blastogenous, which do produce germinal modification, and are therefore of great importance. Prof. Giglio-Tos believes that cytological investigations of the gametes may reveal variations of their structure, for instance, alteration of the number of chromosomes, sufficient to be the cause of somatic changes leading to the formation of new species.

The April number of the *Quarterly Journal of Microscopical Science* (vol. lvi., part iii.) is an unusually attractive one. This is, in part, owing to the beauty of the lithographic plates, nearly all of which, we notice, have been

executed in Germany. Mr. C. Clifford Dobell contributes a long memoir on the much-discussed question of the presence of a nucleus in bacteria. He concludes that "all bacteria which have been adequately investigated are—like all other protista—nucleate cells," but a good deal seems to depend, in making this generalisation, upon how one chooses to define the term nucleus. If, for example, we are prepared to admit that "a discrete system of granules (chromidia)" may legitimately be called a nucleus, well and good, but probably many biologists will hesitate before accepting this view. Mr. Dobell also contributes a memoir on those remarkable unicellular organisms, the spirochæts, with special reference to *Cristispira veneris*, a form occurring in the crystalline style of a lamellibranchiate mollusc (*Venus casta*). Mr. Cresswell Shearer's paper on the trochophore larva of Eupomatus will be welcomed by embryologists as a valuable contribution to our knowledge of Annelid development. The illustrations accompanying this paper are particularly worthy of admiration.

A SEQUEL to the information regarding precipitation and absorption of iron, submitted by Prof. H. Molisch in his book on iron bacteria, is furnished by a note in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (October, 1910), in which he states that various aquatic plants induce precipitation of iron from iron salts, and that Elodea readily absorbs and accumulates oxide of iron in its leaves, in the outer walls of the epidermal cells.

THE elementary species obtained by Prof. de Vries as a break from *Œnothera Lamarckiana*, and designated by him as *Œnothera nanella*, forms the subject of a communication by Mr. H. H. Zeijlstra in the *Biologisches Centralblatt* (March 1). It is indicated that the type of the original diagnosis is an abnormal plant deformed by the internal growth of bacterium colonies, presumably a species of Micrococcus, and that similar characters and form are transmitted to the descendants of abnormal plants. In addition to this, the common form, there is said to be an uncommon but normal form of the species, distinguished from the abnormal chiefly by certain stem and leaf characters, and resembling *Œ. Lamarckiana* except for its dwarf habit; up to the present, seeds of the normal form have not been obtained.

IT is apparent from the experiments on transpiration and sap flow, recorded by Mr. J. B. Overton in *The Botanical Gazette* (January and February), that the umbrella plant, *Cyperus alternifolius*, is a convenient plant for ordinary transpiration experiments. It was particularly suitable for the requirements of the author, whose chief object was to study the effects of killing portions of the stem by immersion in steam or poisonous solutions, as the apical tuft of leaves can be readily slipped through a glass cylinder, which is then fixed at the desired position on the stem. So long as the portion of the stem killed is short, the plant withers less rapidly than a cut piece, but immersion in steam proved to be an unsatisfactory method for killing, as the contents of the cells are disorganised. It was also found that the application of certain poisonous solutions, particularly of corrosive sublimate, causes increased transpiration.

AN extensive and important investigation into the nature of crown-gall of plants has been published by the United States Department of Agriculture as Bulletin No. 213 of the Bureau of Plant Industry, in which is provided a detailed account of experiments extending over six years. A bacterial origin was suspected by Dr. E. F. Smith, one of the authors of the bulletin, in 1904, but definite proof was not obtained until two years later, when a bacterium was isolated, and infection resulting in gall-production was transmitted from pure cultures; to this organism, a short, rod-like form, was given the name *Bacterium tumefaciens*. The inquiry started with galls upon hot-house plants of *Chrysanthemum frutescens*, but subsequently similar malformations were examined on apple, peach, grape, sugar-beet, and other plants; there are probably different physiological races of the bacterium, but cross-inoculation was generally possible. Dr. Smith suggests that the manner of growth resembles certain malignant animal tumours.

Two short papers on seismograms of the great Turkestan earthquake of January 4 are contained in the Journal of the Meteorological Society of Japan for last February. Prof. Omori estimates that the epicentre was situated at about 5230 km. in the direction of N. 65° W. from Tokio, or in the Kashgar province of Turkestan, and that the earthquake occurred at 11h. 16m. 42s. p.m. on January 3 (Greenwich mean time). Two maxima of the principal portion of the movement were recorded, the second 2h. 8m. 27s. after the first, and due to surface-waves travelling over the longer portion of the great circle through Tokio and the epicentre giving the usual mean velocity of 3·1 km. per second for the surface-waves. The total duration of the disturbance was more than four hours at Tokio and 2h. 20m. at Osaka.

IN a recent number of the valuable publication *Aus dem Archiv der Deutschen Seewarte* (No. 4, 1910), Dr. O. Steffens gives an account of new meteorological apparatus constructed or improved by himself. It includes an arrangement, beautifully illustrated, for exhibiting the indications of the aneroid-barometer, thermometer, and hygrometer, either separately or on one cylinder, with rectilinear instead of the more usual curved ordinates. Various anemometers registering direction and velocity separately or on the same cylinder, with damping arrangements for eliminating the small oscillations of the wind-vane, are also described and clearly illustrated.

SOME of the results of the international balloon ascents specially arranged for the week July 27 to August 1, 1908, are summarised by Mr. W. H. Dines in *Symons's Meteorological Magazine* for April. He states that the figures show several points of interest, and would repay a careful analysis; we can only quote here a few facts relating to the particular ascent for each day in which the greatest height of trustworthy record in miles was attained, with the temperature (F.) at the greatest height, the height in miles of the commencement of the isothermal column, the temperature at the bottom of the column, and direction of falling point of the balloon.

		m.	°	m.	°	
July 27	Pavia	14·3	−58	7·5	−78	S. by W.
July 28	Crinan (N.B.) ...	10·7	−58	6·4	−76	E.S.E.
July 29	Pyrton Hill (Oxon)	14·3	−62	8·5	−92	S.
July 30	Zurich	11·2	−72	8·1	−69	W.S.W.
July 31	,, ...	11·3	−65	8·3	−89	S.S.W.
Aug. 1	Strassburg... ...	11·0	−53	7·5	−80	S.E.

No large changes of pressure occurred during the week. On July 27 it was high over the Azores and Lapland; by July 29 it had disappeared over Lapland, but increased over the Azores and moved to the south of Ireland. On July 30 and 31 it had again decreased, but still lay over England, with low pressure on July 31 in the Gulf of Bothnia. On August 1 there was little change.

THE April number of the Journal of the Franklin Institute contains a well-illustrated article on the properties of the new metallic filaments used in incandescent lamps, by

Mr. G. S. Merrill, of the National Electric Lamp Association, Cleveland, Ohio. The properties dealt with are the resistance, melting point, emissivity, and mechanical strength, and the tungsten filament receives most attention. The strength is determined by loading a short length of filament placed on two knife edges half a centimetre apart, at a point half-way between the supports, and measuring the depression under increasing load till the filament breaks. The change in the structure of the filament from a mixture of finely-divided tungsten and binding material, to pure crystalline tungsten as the temperature is raised during manufacture, is well shown by a series of micro-photographs. The effect of use in increasing the size of the crystals and in roughening the surface of the filament is shown in the same way. These changes are accompanied by a decrease in strength of the filament, which occurs mainly in the first 100 hours of use. The conclusion drawn from the observations is that a compact fine-grained structure is most desirable in lamp filaments.

An extension for a further term of seven years of the major part of Sir Oliver Lodge's patent No. 11,575 of 1897 for "Improvements in Syntonised Telegraphy without Line Wires" has recently been granted as a result of a case argued before Mr. Justice Parker, the extension being allowed mainly on the grounds that the patentee had not been adequately remunerated for his invention. The patent covers the radiating and receiving apparatus of a complete system of wireless telegraphy and the methods of tuning the sending and receiving circuits to the same frequency, and describes how messages may be sent to each of a number of suitably tuned receiving stations by change of the frequency of the oscillations that are generated. The aërials described are of different forms, but all consist of a pair of "capacity areas" connected by inductances the magnitudes of which control the period of oscillation. The eleven claims of the specification are concerned with the insertion of these inductances into the radiating and receiving circuits; with the adaptation of a single aërial for sending and receiving the insertion in turn of inductances of various magnitudes in order to attain the selectivity already referred to; with the details of a coherer consisting of a fine metal point resting on a flat metallic spring; and, lastly, with methods of setting up the oscillations by discharges into the oscillator across air-gaps and receiving through an oscillation transformer, in order to separate both the oscillator and the resonator from metallic connection with other circuits, thus enabling them to vibrate in their own free periods so as to get precise tuning. The whole specification has been extended for the further term except the portions covering the use of the same circuits for sending and receiving, the use of various frequencies to select various receiving stations, and the use of the particular form of coherer. It thus appears that the patentee holds a master-patent covering the tuning of electrical circuits by means of inductances, and as the use of such tuned circuits is common to methods of signalling used by wireless telegraph companies operating in England, the situation will probably give rise to interesting developments.

The report of the council of the Hampstead Scientific Society for the year 1910 shows that the object for which the society was founded in 1899, namely, the encouragement of a popular interest in science, has been pursued diligently and successfully. During the year eighty new members were elected, the membership rising to 334, the largest in the history of the society. Twenty-nine meetings, general and sectional, were held in 1910, in addition to five vacation meetings, a summer excursion organised by the photographic section, and four Christmas lectures to juveniles. The feature of the society's work for the year was the development of the astronomical section since the establishment of the observatory near the Whitestone Pond. The meteorological station at the same place has been efficiently conducted. An observer attended at 9 a.m. and 9 p.m. every day during the year, without intermission, and the results, after reduction, have been published monthly by the Meteorological Office.

The Carnegie Institution of Washington has issued a list of the various works which it has published, together with those it has in the press. Copies of each publication, except the Index Medicus, are sent gratuitously to a limited number of the great libraries of the world, and the remainder of the edition is on sale at cost price. As the catalogue shows, this arrangement enables workers in science to obtain accounts of many important researches at a minimum cost. Descriptive lists of the books available will be sent to any interested person on application to the Carnegie Institution of Washington, Washington, D.C.

A supplement—covering works added to the library during the years 1908–9—to the Catalogue of Lewis's Medical and Scientific Circulating Library has been issued from the library at 136 Gower Street, London. The catalogue, the price of which is sixpence, contains a classified index of subjects with the names of the authors who have treated upon them, in addition to the ordinary alphabetical list of titles.

OUR ASTRONOMICAL COLUMN.

New Minor Planets.—A Central News telegram of Tuesday states that the Transvaal Observatory reports the discovery of two minor planets. The discovery was made during an attempt to photograph the eighth satellite of Jupiter. The following are the positions of the new planetoids:—No. 1, R.A. 14h. 41m., Dec. 12° 34′ S.; No. 2, R.A. 14h. 48m., Dec. 15° 18′ S. It is stated that these are the first minor planets found by an observatory south of the equator.

Nova Lacertæ.—Photometric measures of Nova Lacertæ, made between January 4 and March 15 by Mr. H. Shapley at the Laws Observatory, are recorded in No. 4493 of the *Astronomische Nachrichten*. During that period there was a general decline of brightness from mag. 7·67 to mag. 9·23. Four neighbouring B.D. stars were used for comparison, and it is suggested that one of them, B.D. + 51° 3420 (mag. 8·7), is a variable with a range of at least 0·4 magnitude; if this is so, several anomalies in the photometric results may be explained.

In the same journal Dr. Slocum records observations of two coloured B.D. stars near the nova, to which M. Luizet previously directed attention and suggested that B.D. + 51° 3414 diminished in brightness by 1·5 magnitudes between January 2 and February 21. The photographic observations at Yerkes, with coloured screens, indicate that both stars are abnormally coloured, B.D. + 51° 3416 showing a greater preponderance of red rays and B.D. + 51° 3414 a greater preponderance of rays of shorter wave-length than a normal star of the A type.

Halley's and Faye's Comets.—An observation by Prof. Barnard, using the 40-inch refractor, showed that on March 19 Halley's comet was of magnitude 13·5, and very easy to observe. It was round, and the middle showed a slight brightening, with possibly a faint, but uncertain, nucleus; its measured diameter, probably too large, was 45″ (*Astronomische Nachrichten*, No. 4492).

Dr. Ebell continues his ephemeris, giving places and magnitudes for Faye's comet (1910*e*) up to May 14. At present the comet is about 20 m. and slightly north of

ξ Geminorum, and its calculated magnitude is 15·0. The observation by Dr. Wolf on March 19 showed the actual brightness to be about one magnitude fainter than the ephemeris value (*Astronomische Nachrichten*, No. 4485).

PROPER MOTIONS IN SUN-SPOT GROUPS.—Dr. W. Brunner, Zurich, has an important and interesting paper in No. 3, vol. xl., of the *Memorie di Astrofisica ed Astronomia*, in which he discusses the relations existing between the proper motions observed in spot-groups and the solar activity producing the groups. The discussion is based on the examination of Wolfer's Zurich drawings for the period 1887–1905, and the spots born on the visible hemisphere are considered separately from those which, having first broken out on the invisible hemisphere, are first seen at the eastern limb; only the proper motions in longitude are discussed, and, in general, these are in the sense which makes the various members of the group diverge *inter se*.

The general conclusions, in brief, are that this divergence is not accidental, but is connected with the phase of development of the group. In the early stages of development the diverging tendency is strongly marked, but it rapidly wanes until it disappears seven or eight days after the first outbreak, unless a recrudescence of activity takes place, when the same phenomena reappear. Taking as positive the proper motion, which is in the direction of the diurnal motion, it is found that the groups in which negative motion is dominant are more numerous at the epochs of maxima in the undecennial period. But it is found that the magnitude of the proper motion is independent of the phase of the solar activity and also of the heliographic latitude. As naturally follows from the first conclusion, those spots born on the invisible hemisphere, being several days old when first seen, exhibit the proper motions in a less marked degree than those of which the primary phases of development are observed.

THE RATIO BETWEEN THE DIAMETER OF A PHOTOGRAPHIC IMAGE AND EXPOSURE.—In the measurement of photographic magnitudes by measuring the diameter of the star images it is assumed, in the formula usually employed, that the diameter is proportional to the square of the intensity of the light. Not agreeing with the principle of this assumption, Dr. Kenneth Mees recently made some experiments, under laboratory conditions, in which he produced easily measurable images with greatly differing exposures. He finds that the diameter of the small image of a fine slit or point is proportional to the logarithm of the exposure given, and assuming that increase of exposure is effectively equivalent to increase of intensity, this would mean that the diameter of a star image should be proportional to the logarithm of the intensity of the light-source rather than to its square. Dr. Mees suggests that the astronomical equation is based upon a modification of the true law dependent on the conditions of the formation of images in telescopes (*Astrophysical Journal*, vol. xxxiii., No. 1).

PHOTOGRAPHIC MEASURES OF STELLAR TEMPERATURES AND DIAMETERS.—In No. 4483 of the *Astronomische Nachrichten* Herr Adolph Hnatek publishes an interesting paper on a photospectroscopic method of determining the effective temperatures and relative diameters of stars. The photographic intensities of various parts of the spectrum are compared, and from the resulting data a temperature scale is formed. This ranges from 4000° for η Pegasi to 11600 for Algol, eight stars being considered, and agrees fairly well with the Potsdam values where comparable. It also places the eight stars in the progressive order shown by the Kensington temperature curve. The comparison of diameters shows that α Lyræ is 6·1 greater than the sun, whilst α Aquilæ is but 1·9 times greater.

CANADIAN OBSERVER'S HANDBOOK FOR 1911.—An excellent handbook for amateur and other astronomers is issued by the Royal Astronomical Society of Canada, and edited by Mr. C. A. Chant. The first two numbers were published in 1907 and 1908, and then the experiment of publishing the information in instalments in the society's Journal was tried. This proved unsatisfactory, and the former custom of having a separate volume has been reverted to. The book should prove of invaluable assistance to the rapidly growing body of amateur astronomers in the Dominion, and it is hoped to publish the volume for 1912 before the beginning of the new year.

THE IMPERIAL EDUCATION CONFERENCE.

THE public sessions of the first conference of delegates summoned by the British Government to represent the Overseas Dominions were held in London on four afternoons, April 25–28. The President of the Board of Education welcomed the representatives, and presided at each meeting. Administrative problems were, it is believed, discussed at the morning sessions, to which only the official delegates were invited. The proceedings at these morning meetings were private, the conference agreeing at its first meeting that, in order not to hamper discussion, no report should be made until the close of the conference, when an official summary will be issued. At the time of writing, all that can be said with certainty is that the private sessions are being prolonged into the week following the public meetings. Admission to the afternoon discussions was by tickets issued to representative administrators and teachers. The attendance of the overseas delegates in the afternoons was not large. The programme drawn up by the Board of Education included papers on the teaching of geography, history and arithmetic, manual work, the organisation of secondary education in Scotland, engineering, and vocational education. All the papers were by well-known British workers in the educational field.

Chairman's Prologue.

Mr. Runciman said that the conference originated from requests made in 1907 to the Imperial Government to summon an Imperial Conference to deal purely with educational affairs. ("The Federal Conference on Education," held in 1907, was initiated by the League of the Empire, and was unofficial and highly successful.) Since 1907 the Department of Special Inquiries and Reports had been in direct communication with the Dominions, India, and the Colonies, there had been improved circulation of reports, and memoranda had been compiled during the four years which would be issued shortly. Assistance was being given every day in the week in the selection of teachers, *e.g.* for Alberta, Australia, and South Africa. They had also arranged through the Department that the privileges now given to the teachers in the United Kingdom in French and German schools should be extended to teachers throughout the Empire. Assistance was continually being given to visiting officials. A library of considerable dimensions had grown up containing carefully selected and organised contributions from all over the world. The problems to be faced here and overseas were very similar. There were the difficulties of the supply and training of teachers, the problem of giving freedom of organisation while retaining control of finance. All the subjects of pedagogy were of universal interest. They had to deal with the puzzle of the classification of schools, with rural, urban, and technical problems. The United Kingdom might learn from Canada, Canada from Australia, Australia from South Africa, and so forth. They wished to bring to the common stock the intellectual forces of the whole Empire, and feed the very root of Imperial strength. The Empire was a practical working concern, not merely a sentimental vision, and they were met to discuss practical questions.

Imperial History and Geography.

Mr. H. J. Mackinder, M.P., read a paper on the teaching of geography from an imperial point of view, and the use which could and should be made of visual instruction. He asked for attention to a mode of teaching which might have peculiar value in the consolidation of the Empire, a work in which the part of the teacher must be as great as that of the statesman. The Empire existed by the free consent of the peoples, and this consent must be based on a reasonable agreement in regard to aims and sympathy in regard to difficulties. It was the part of the teacher to exorcise the devils of ignorance and local prejudice. Geography should be taught as a special mode of thought—a special form of visualisation which he would not describe otherwise than as "thinking geographically." He went on to describe the work of the Visual Instruction Committee, and concluded by urging that geography should be the chief outlook subject in our school curriculum, and should be taught by methods which demand visualisation. We should aim at educating the citizens of the many parts of the British Empire to

sympathise with one another and to understand Imperial problems by teaching geography visually, not only from the point of view of the Homeland, but also of the Empire. Among many other excellent aids to such teaching, there was now becoming available an apparatus of illustrated lectures prepared under the authority of the Visual Instruction Committee of the Colonial Office. Prof. H. E. Egerton, Beit professor of colonial history (Oxford), followed with a paper on some aspects of the teaching of imperial history. He dealt mainly with three subjects:—(1) the mercantile system; (2) the evolution of Colonial self-government; (3) the development of the Federal principle. The mercantile system assumed colonies to be plantations, *colonies d'exploitation*; what was to happen when they proved *colonies de peuplement*, settlements of men? The idea of a self-sufficing Empire postulated a general controlling Parliament; what was to happen when this Parliament represented the selfish interests of one particular portion of the Empire? Round the single principle of the mercantile system they had all the causes which led to the development and dissolution of the first English colonial empire. They would all admit that the evolution of Colonial self-government was a subject which, on a smaller scale and with simpler material, would bring out the underlying principles of the British Constitution. Referring to the Federal principle, Prof. Egerton declared that a more systematic organism must be found for the disjointed portions of the British Empire. For such an undertaking there could be no better preparation than the study of what has been done by our kinsfolk in the past.

The discussion was well maintained by well-known English teachers, but unfortunately no Colonial delegate spoke.

Arithmetic in Elementary Schools.

At the second public session Mr. Marshall Jackman read a paper on experimental work in connection with the teaching of arithmetic in elementary schools. The word "experimental" was justified by the fact that the methods employed were a departure from the Code at the time, ten years ago, when Mr. Jackman adopted the principles on which he has successfully worked ever since. These principles may be inferred from the facts that (1) the concentric method is adopted; (2) no set method of solving a problem is insisted upon; (3) the terms used in the problems are familiar to the children and the problems dealt with transactions within their grasp; (4) no problem is set which cannot be solved mentally. He claimed that, in addition to securing the teaching of arithmetic on more rational lines, the methods pursued set free more than eighty minutes a week in the three lower classes of the school; this time was devoted to reading with most beneficial results. Mr. J. V. Thompson (Fiji) said he had attempted to teach arithmetic to young Fijian chiefs in a language not their own. The Fijians delighted in exercise books, and the native master liked to set his class an enormous division sum, knowing that he would then have a most restful half-hour. He would take Mr. Jackman's scheme with him and use it.

Practical Education in Elementary Schools.

Mr. J. G. Legge, Liverpool Director of Education, read a paper on the above subject, and directed attention to the influence of the changed social conditions brought about by the industrial revolution. Of old, education was as much the work of the home as of the school. But the home side had been fading away, and despairing—perhaps too soon—of ever recovering it, we were rushing in where angels might hesitate with proposals for feeding and clothing, medically treating, and apprenticing. After the child is officially taught, officially fed, officially clothed, and officially placed in employment, there but remains the prime condition, to which eugenics is already pointing the finger, that he shall be officially begotten. As a result of a study of educational history, we discovered that manipulative exercises were not mere counter-irritants to book-work, but the right method of applying the universally accepted principles of Pestalozzi. Recently, experimental psychology has taught us that hand training *must* precede trade training if dexterity is to mature in perfection. Henceforward we may base our claim that manipulative exercises shall find a place in our elementary-school curricula, for six reasons, viz.:—(1) to develop centres in the brain; (2) to develop manual dexterity at the age when it must be developed if it is to reach the pitch it should in maturer years; (3) to afford scope for self-expression; (4) to make school subjects more real to the child and to bring in the third dimension; (5) to keep the child in touch with its environment; (6) to give the child something to do which it recognises as definitely useful, and thereby to implant the germ of the idea of usefulness, the fruit of which is social service. Variety of schemes will be necessary; but in any case the limit of the manual side is the point at which it ceases to develop the all-round, intellectual as well as physical, development of the child. By manual work a boy is taught to think clearly towards an end believed by him to be useful. The child should make something for its own use or the use of its home. In a slum school a boy should learn to mend his own breeches, socks, or boots—for educational reasons.

Secondary Schools in Scotland.

Mr. J. Strong described the development of the organisation of secondary education since the passing of the Act of 1872. By control of the leaving certificate examination and virtual control of grants, the Scotch Education Department had a great hold on the secondary school. Curricula, buildings, and the qualifications of teachers were subject to the approval of the Department. A virtual register of teachers had been made, and a high standard fixed for training. To the Department was entrusted the administration of the teachers' superannuation scheme of the 1908 Act, which applies to secondary as well as elementary teachers. Mr. Strong explained the classification of schools and the system of certificates and transition to higher schools, university, or vocations in a lucid manner. Mr. Board (New South Wales) said that in New South Wales they had followed very closely on the lines of Scotland, with the important exception that they had no local control. Centralisation had some disadvantages, but on the whole the gain was greater than the loss. They would hesitate before dividing into such small areas as in Scotland.

Engineering and Technical Education.

Dr. J. A. Ewing, Director of Naval Education, said that the ideal training for the engineer was one which comprised, in addition to means of getting experience, a properly organised course of study in the relevant sciences taught with reference to their practical application. Science helped to determine everything the engineer did. After explaining some features in the organisation of leading engineering schools, he said the engineering professor ought to encourage his better senior students to undertake research, which was vital to the progress of engineering science, and was one of the duties of the college. Experience had proved that the use of tools could be so taught in a college workshop as to have solid professional value. He did not suggest that such an element in the training of engineers could entirely take the place of practical work done on a larger scale under commercial conditions, but much of what apprenticeship was designed to teach could be taught more effectively that way and in less time.

Mr. J. H. Reynolds (Manchester) read a paper on higher technical instruction. In his opinion, no reform in England was more urgent than that secondary schools should receive State recognition, be relieved from external examinations, and have their leaving certificates accepted by higher institutions as giving complete and satisfactory evidence of fitness to enter upon a further stage of advanced study. In 1869 this country was a generation behind Germany, and it was hardly less so to-day. In the United Kingdom the enrolments of students in higher institutions possibly reached 40,000; but in the German Empire the total enrolments were nearly 74,000, whilst the age of entrance and the state of preparation required was admittedly much beyond that prevailing in this country. The doom of the nation was surely set unless they rose up and provided for the people the means of the highest education, alike in their best interests as human beings and as needful for the maintenance and development of her trade and industry.

The discussion was maintained by several men of

eminence in English engineering education, but no Colonial representative took part.

Trade Schools and Continuation Schools.

Mr. R. Blair (London Education Officer) read a paper on the recent development of day schools for boys or girls following immediately on the close of the elementary-school career, the schools being so closely associated with the industry for which they are preparing their students that the preparation is a substitute for the earlier years of apprenticeship. He directed attention to the extent and peculiarities of London's needs, and his valuable remarks were supported by a large amount of useful statistics appended to his paper. He selected for detailed description the work of the Brixton School of Building. The paper is one to be read in full and kept for reference; we must content ourselves with noting that Mr. Blair attributes the success of the schools to the thoroughness of the investigation made into the conditions of a trade before establishing a school or class, and to the appointment of a consultative committee of experts. The striking success of the girls' schools was due to the high standard of devotion and enthusiasm of the staff.

Mr. Graham Balfour (Staffordshire) showed how complicated and varied were the difficulties in organising continuation schools, and the need for resourcefulness and judgment in dealing with each individual locality.

Mr. C. E. Bevan Brown (Christchurch, N.Z.) said that recently an Act had been passed in New Zealand allowing local authorities to make continuation classes compulsory.

A Criticism and a Hope.

Had the papers and discussions been the British part of proceedings to which the Overseas Dominions had contributed a similar share, we should feel that these conferences had made a good beginning. It is to be hoped that when the report of the private sessions appears it will reveal the fact of a useful interchange of experience and ideas between the delegates of the various parts of the Empire. So far as the public sessions are concerned, it cannot be said that a programme consisting solely of contributions from the United Kingdom fulfils even approximately the aspirations with which we regard an Imperial Education Conference. It has been stated in the daily Press that the Colonial Governments were not invited to make suggestions for the business of the conference. In face of the fact that the Board of Education had four years for preparation, this statement appears to us incredible, or, if credible, then discreditable. We hope that one result of the private sessions will be to evolve a method by which the various parts of the Empire can act in concert, so as to carry out in future those aims of the conference which were stated with clear insight by the President of the Board in his opening address.

G. F. D.

BIRD NOTES.

To the April issue of *British Birds*, Messrs. Witherby and Alexander contribute an account of the visitation of crossbills to the British Isles in 1909. The birds made their appearance on Fair Isle on June 23, and before the end of that month were seen in the Shetlands, Orkneys, Outer Hebrides, Merionethshire, and Durham; while in July they were observed all over England except the extreme south-west, as well as in a number of places in Wales, and a few scattered localities in Ireland. The latest record of their being seen at sea was in the Shetlands early in August. The first nest recorded was taken on January 12, 1910, near Thetford, while the latest nests were seen respectively in Sussex and Kent on May 25, the height of the breeding season being in March and April. Nests were recorded from thirteen English counties. The dates of departure of the birds varied locally; in some districts all had gone by the end of 1909, in others there was little or no diminution in the numbers till well on in the following year, but, as a whole, the records indicate that the main departure took place either in February or in April and May. From a second paper in the same issue, it appears, however, that a few crossbills remained to breed in certain localities in the spring of the present year. A note is added in the latter paper on the thin-beaked Scots crossbill (*Loxia curvirostra scotica*), which breeds regularly over a considerable area in Scotland.

The Irish Times of March 31, as quoted in *The Field* of April 8, reports an enormous influx of migratory birds into Ireland, especially the south-eastern districts, during the last week of March. In New Ross on the night of March 29 the town was practically invaded by a vast swarm of starlings, while in Kilkenny on the same day the streets were strewn with the dead bodies of various species, including curlew, while much the same thing happened in Carlow on March 30. There can be little doubt that the influx and subsequent destruction were in some way connected with the abnormally cold weather prevalent at the time.

In *The Emu* for January, Mr. A. J. Cambell describes, under the name of *Erythrotriorchis rufotibia*, a new species of so-called Australasian goshawk, characterised by the rich rufous or chestnut brown of the shank of the leg. This bird inhabits north-western Australia; the other members of the genus are *E. radiatus* of eastern, northern, and central Australia, and *E. doriae* of south-eastern Papua.

To *The Selborne Magazine* for April, Mr. A. H. Macpherson contributes notes on London birds in 1910, in which reference is made to the visit of a great crested grebe to the Serpentine on January 29. To illustrate the article on account of this casual visit with a figure of a nesting grebe, is, perhaps, a little misleading.

Mr. V. Franz gives, in *Himmel und Erde* for March, an illustrated account of the bird-observing station at Rossitten, with figures of the modes of ringing birds' feet, and notes on some of the results which have been obtained by the system of bird-marking.

From a paper by Mr. Grinnell issued in vol. vii., No. 4, of the Zoological Publications of the University of California, it appears that the Californian linnet (*Carpodacus frontalis*) was introduced into the Hawaiian Islands about forty years ago, and that the males of the race now established there differ from the normal form of their continental brethren by the replacement of the crimson head and breast colouring by yellow or orange. This pale colouring of the cock Hawaiian linnet is paralleled sporadically by the linnet of the mainland in a wild state, and constantly in birds kept in confinement. As the change in the Hawaiian bird does not appear to be due to differences in temperature or humidity, change of food, or a diminution in the number of foes, it appears to be connected with deep-seated factors, one of which may be insularity of habitat. "A deficiency in capacity, of the germ, for the formation of the appropriate enzyme may have been intensified through close breeding until the condition was reached where the amount of enzyme produced in the feather anlage is insufficient to carry on oxidation of tyrosin beyond the yellow, or, at farthest, the orange stage.

R. L.

OPTICALLY ACTIVE ALCOHOLS.

The January issue of the Chemical Society's Journal contains an important paper by Dr. R. H. Pickard and Mr. J. Kenyon on the "Dependence of Rotatory Power on Chemical Constitution." Hitherto much of the work that has been done in order to find out the influence on optical rotatory power of temperature, solvent, concentration, and chemical constitution has been based upon the observations of complex compounds, such as nicotine and derivatives of various complex acids and bases. These substances have the advantage that they can be purchased as natural products in optically active forms, but the complexity of their structure has rendered it almost impossible to draw any general conclusions from the vast array of facts that have now been accumulated. In the research now described the authors have endeavoured to reduce the problem to its simplest possible form by studying the properties of the series of secondary alcohols, $R_1.HOH.R_2$, of which the simplest member is secondary butyl alcohol, $CH_3.CHOH.CH_2.CH_3$.

Up to the present no fewer than fourteen of these alcohols have been prepared, and separated into their

optically active constituents by fractional crystallisation of the alkyl strychnine phthalates, $R.O.CO.C_6H_4.CO.O.X$, or similar salts, in which R is the alcohol radical and X is a suitable alkaloid; of these fourteen alcohols, only one had previously been obtained in an optically active form.

The labour involved in resolving so long a series of compounds can scarcely be appreciated except by those who have taken part in similar investigations, but in the present case the effort has been well rewarded by the production of material of unrivalled value for elucidating all the various problems involved in the study of optical rotatory power. The complete series of alcohols from $CH_3.CHOH.C_2H_5$ to $CH_3.CHOH.C_{11}H_{23}$ shows a perfectly regular gradation of properties, except in the case of the initial member, which shows an exceptionally large decrease of rotatory power with rise of temperature.

As illustrating the extreme sensitiveness of rotatory power to small changes of conditions, it may be noticed that ethylhexylcarbinol, $C_2H_5.CHOH.C_6H_{13}$, in complete contrast to methylhexylcarbinol, $CH_3.CHOH.C_6H_{13}$, or the methylheptylcarbinol, $CH_3.CHOH.C_7H_{15}$, with which it is isomeric, has a positive instead of a negative temperature coefficient, the rotatory powers of the isomeric alcohols being equal at 70°, but diverging when the temperature is raised or lowered. An even more drastic change of properties is observed on passing from phenylethylcarbinol, $C_6H_5.CHOH.C_2H_5$, to phenylmethylcarbinol, $C_6H_5.CHOH.CH_3$, or from methylbutylcarbinol,

$$CH_3.CHOH.C_4H_9,$$

to the isomeric methyl*iso*butylcarbinol,

$$CH_3.CHOH.CH_2.CH(CH_3)_2,$$

whereby the rotatory power is almost doubled in each case.

THE TEACHING OF SCIENCE IN SECONDARY SCHOOLS.[1]

THE following notes on the subject of science teaching in grant-earning secondary schools in England are based on the reports and observations of certain of the Board's inspectors, who were instructed to pay special attention to this matter during the past year. While an attempt will be made to note the principal changes that have occurred in recent years, to point out certain directions in which improvements have taken place, and to direct attention to some existing defects, the time has not yet come when a detailed and systematic survey of the state of scientific instruction in English secondary schools could profitably be undertaken. Since 1902, when the schools of science or "organised science schools" of the Science and Art Directory became the Division A Schools of the Regulations of that year, the number of secondary schools recognised for grant has risen from 348 to its present figure, 841. The earlier portion of this period was one which saw a gradual transformation from curricula which were predominantly scientific and mathematical to curricula in which a more even balance of studies was secured; and the whole period of growth and transition has been characterised (quite apart from the effect of alterations in the Board's Regulations) by notable changes in the methods, and to some extent also in the aims, of science teaching.

Changes in the Board's Regulations.

A comparison of the Regulations which in 1902 applied to the 221 schools in Division A (consisting in about equal proportions of municipal schools and higher grade board schools on one hand and schools of the endowed-school type on the other) with the Regulations now in force will show the magnitude of the change which has been brought about in the conditions under which the teaching of science in this section of the grant-earning schools is carried on. Thus in 1902 not fewer than thirteen hours a week were assigned to the obligatory subjects—mathematics, physics, chemistry, drawing, and practical geometry—of which not more than five hours might be assigned to mathematics. Even in the 127 schools belonging to the "Division B" of the Regulations of 1902, nine hours a week, or alternately a third of the total number of hours of instruction, were assigned to mathematics and science, of which four hours, or alternatively half the required minimum for both subjects, were allotted to science. Moreover, the Board not only determined the time which was to be allotted to science in each year of the "course," but indicated the syllabus to be followed in the various subjects of the "advanced courses" taken by the "Division A" schools. At the present time the Board's Regulations impose no conditions as to the syllabus of work to be followed and make no specific requirements as to the time to be assigned to the different subjects of the curriculum. Side by side with the increased freedom which has been given to the schools there has, as a fact, been a considerable reduction in the amount of time allotted to science in schools of the "Division A" type and to some degree also in schools of the "Division B" type. In schools of the former class the time given has commonly been reduced from some seven or eight hours a week to four or five in the upper forms, while in the lower forms the proportionate reduction has been greater. This has entailed considerable modification in the syllabus of work and, in general, a lowering of the possible standard of attainment.

Subjects Studied.

In practically all boys' schools the subjects taken are chemistry and physics, while in the majority of girls' schools botany is the main science subject, a minority taking either physics or more often chemistry. It is usual both in boys' and in girls' schools to find the study of one or other of these subjects preceded by a course of "experimental science" in which the formal separation into chemistry and physics is deliberately avoided. A considerable number of girls' schools, however, still exist in which botany is the only subject taken, or in which the attempt is made to teach botany concurrently with "experimental science"—a plan which, owing to the limited amount of time available, is rarely found to work well.

Hygiene, taught as a science subject, finds a place in the courses of a relatively small number of girls' schools and of a certain number of mixed schools, the subject being taken by the girls only. The inclusion of hygiene in the course is, as a rule, justified primarily on ethical grounds, *i.e.* with a view to the inculcation of hygienic habits. It is perhaps scarcely necessary to observe that there are wide differences of opinion as to the extent to which it is necessary or practicable to give this ethical teaching a formal scientific basis. The number of schools in which other science subjects, *e.g.* geology, astronomy, and zoology, are taught is exceedingly small, though there is some incidental teaching of the two former subjects in connection with the work in geography, while zoology very occasionally appears, and then for examination purposes, in the courses taken in the upper forms. Nature-study, a conveniently elastic term which covers work of the most various kinds, is ordinarily included among the subjects taught in the junior departments of both boys' and girls' schools. The subject is best taught when it is in the hands of a teacher (not necessarily the teacher of science) who is an enthusiast on natural history. In too many girls' schools in which botany is the main science subject the mistake is made of limiting the work to a preliminary study of plant life supplemented, it may be, by the making of weather records. In a few schools the plan of closely associating the early work in geography with nature-study has been tried with encouraging results.

Courses of Work.

(*a*) The differences which exist, and still more perhaps the differences which ought to exist, between the curricula of different grant-earning secondary schools make it practically impossible to comment in general terms on the character of the science work attempted and the standard reached in the several subjects taken. The probable after-careers of the pupils, the facilities for teaching individual subjects offered by the school and its environment, and the time which it is found possible to devote to science teaching are determining factors on which the choice of sub-

[1] From the Report of the Board of Education for the year 1909–10 London: Wyman and Sons, Ltd.). Cd. 5616. Price 8*d*.

jects, the range of the work, and the possible standard of attainment will necessarily depend. A course which is suitable in one school may be quite unsuitable in another. In those schools from which a certain number of the pupils pass on to university work in science, and in which a fair proportion remain until seventeen and over, or in which the course is definitely specialised (*e.g.* schools with a "rural bias"), the problem of the science syllabus tends indeed to solve itself; but in the large number of schools in which school life ends not later than sixteen, this is not so. If in these schools the best possible use is to be made of the time available, it is plainly desirable that the syllabus should represent something more than the initial stages of a study which the pupils will never continue—that it should have, in fact, a purpose and completeness of its own. Again, on the general principle that the curriculum of a school should be narrowed at the top, it should follow that in a certain proportion of schools the allowance of time would be such as to enable boys of sixteen or seventeen to attain a standard in more than one science subject over and above the limited standard required for "school leaving" or "matriculation" examinations. In schools of this type it may well be the function of the science teachers to save the curriculum from the dangers of an all-round mediocrity. This will apply more particularly to urban schools from which a considerable number of pupils pass on to scientific or quasi-scientific occupations.

(*b*) But whatever the circumstances of the school, no treatment of the science work can ever be satisfactory which leaves wholly out of consideration the relations of science to other subjects in the curriculum. Mathematics is an obvious case in point. The adoption of the same reclassification of the pupils for both mathematics and science is a plan for which there is very much to be said; but in the smaller schools there are practical difficulties in the way, which account for the fact that this expedient is rarely adopted. On the other hand, it is much to be wished that a certain proportion of teachers should be encouraged to qualify themselves to take both these subjects, and, questions of organisation apart, that teachers of physics and mathematics should always work in close touch with one another. In this connection a special point (which has received frequent notice in inspection reports for several years past) may be mentioned. It is very desirable that mensuration, which in a considerable number of schools is still included in the science course, should be transferred to its proper place in connection with the teaching of arithmetic to boys and girls in the junior departments. If this were done it would be possible, and often advantageous, to amplify the course in practical physics by the introduction, at some stage in the course, of experimental work in elementary mechanics, a subject which at the present time is too often neglected in schools. In addition to mathematics, geography, advanced manual instruction, and domestic economy may all contribute elements of value to the teaching of science, and be in turn assisted by it. It is necessary, however, to add the warning that the teacher who endeavours to teach two subjects in one may succeed admirably in teaching neither.

(*c*) The detailed syllabuses in particular subjects show in many cases curious, if not inexplicable, limitations. There is, for example, a tendency to refrain from all mention of scientific matters of common interest, because they do not admit in school work of complete and exhaustive treatment. Electricity and magnetism (including magnetic measurements) form part of the work in many boys' schools, but the motor and the dynamo are not even mentioned, because time does not permit of the study of electromagnetism. Every child is interested in soap bubbles, but the majority of boys and girls are not introduced to the simplest consideration of the phenomena connected with surface tension. There is no subject more generally studied than heat, but if a boy leaves school with any knowledge of how a locomotive works it will usually be the result of his own unaided researches. It is certainly unfortunate that pupils who learn science should be sent out into the world wholly ignorant of matters in which they are naturally disposed to be interested. Syllabuses of work, admirable for the purpose of instilling scientific method, may and sometimes do err in the direction of being inhuman.

(*d*) In the same way, it is important that in the actual teaching every opportunity should be taken of illustrating facts and principles learnt in the laboratory by frequent reference to everyday phenomena. This is a matter which requires the most careful attention in boys' schools no less than in girls' schools, in physics no less than in chemistry. Appropriate illustrations give a reality to the work which it sometimes lacks. They should, of course, be introduced as *illustrations*, that is to say, when, and only when, they may happen to be wanted to give point to the teaching. They are useful just in so far as they serve this purpose, and just in so far as it is remembered that the teaching is concerned with science and scientific method, and only in a secondary sense with its application to industry and the arts.

(*e*) Again, it is probably neither possible nor desirable to add to the number of science subjects which the pupils will systematically study in the laboratory and the class-room. There is the more reason why they should be encouraged to interest themselves in some aspects of nature other than those to which attention is given in school hours. For this the "school scientific society" may offer the needed opportunity by providing for the older pupils the occasion of taking up subjects for themselves and sharing their interests with their fellows.

Equipment.

In the matter of laboratory accommodation and equipment it is satisfactory to note that local authorities and governing bodies of endowed schools have commonly shown a generous appreciation of the requirements of science teaching. It is comparatively rare to find, except perhaps in connection with the teaching of botany, that the work is seriously handicapped by deficiencies in equipment, and the occasional suggestions of inspectors under this heading are directed, as a rule, to securing a suitable adaptation of the arrangements of the older laboratories to modern requirements. These will naturally vary in different schools with the character and extent of the course of work attempted, and it is for this reason desirable that the authorities concerned in the planning of new or the alteration of existing laboratories should take every opportunity of effectively consulting the responsible teachers. It is sometimes forgotten that space is more valuable than elaborate fittings, and that suitable provision for upkeep and apparatus is essential to the proper conduct of a laboratory. Economy and efficiency alike demand that a laboratory should not be regarded as something ready-made which can be ordered once for all from a manufacturer. On the contrary, when the essentials have been provided, a laboratory, like a library, should be allowed to grow.

Influence of Examinations.

Any consideration of the present state of science teaching would be obviously incomplete if it avoided all reference to the effects of examinations. In this connection, then, it is satisfactory to observe that the work of the schools, at any rate in the lower and middle forms, is far less determined by examination requirements than was the case even a few years ago, and that there is an increasing tendency among teachers to be guided in their teaching by strictly educational aims. At the same time there has been a marked improvement in the character of the syllabuses of certain examinations commonly taken, and a consequent improvement in the character of the work attempted in many of the schools. Notwithstanding this, it has to be recognised that a detailed syllabus put forward by an examining body, however unexceptional the syllabus may be, has its inevitable disadvantages; for it is only too likely that when a teacher has such a syllabus before him, his teaching will follow a predetermined line, whereas in connection with the teaching of science it is especially desirable, not only that the teacher should, within limits, make his own syllabus, but that he should feel free at any moment to depart from it. An examina-

tion may be unsuitable in a particular school either because the syllabus is so restricted that the last year's work tends to be a mere repetition (sometimes with a minimum of practical work) of what has gone before, or because the syllabus in a particular subject—chemistry, for example—covers so wide a field that the teachers in the limited time available practically confine themselves to this subject alone, and in dealing with it are forced back on mere bookwork and informational teaching.

Relation of Theoretical to Practical Teaching.

Attention has been frequently directed in the reports of inspectors to the necessity of establishing a right relation between the theoretical and practical teaching of science. By this is meant, not only that the two modes of treatment should be closely associated with one another, but that they should be placed in their right order. In this important matter there has been a notable improvement in the methods of teaching followed in the schools, and criticism in this region is likely in the future to be more concerned with details than with matters of principle. Though opinions differ as to the precise methods by which the desired results are to be secured, it is now very widely recognised that the teaching of a class should, so far as possible, be based on the practical work done by the members of the class. As a fact, lectures have largely given place in elementary teaching to class discussions on the practical work assisted by occasional demonstrations, and the change has been beneficial to the work of the lower and middle forms. In some cases, however (as will be pointed out later on), the practical work has not been supplemented by any adequate discussion of its results. In other cases, the reaction against formal lectures has gone so far as to lead teachers to rely exclusively on the experiments carried out by the class. There is reason to think that when this is done the teaching loses in effectiveness.

Practical work in the lower and middle forms ordinarily follows on a brief discussion of the matter to be investigated, and a written account of the experiment to be carried out is regularly required. Such written accounts should, of course, be the outcome of the pupil's own efforts, and not be, to all intents and purposes, dictated by the teacher or copied from a book. So far as these records are concerned, there has been of late considerable improvement. The mechanical entering up of results in spaces set apart for the purpose, or the filling up of columns under the headings "experiment," "observation," "inference," has nearly disappeared; but more remains to be done in regard both to the form and substance of the record. The idea that there are two standards of composition, one which is appropriate for the English lesson, and another which is good enough for the science laboratory, has not yet been eradicated. But, apart from this, the notebooks often include accounts which are satisfactory in so far as they are purely descriptive, but which fail to show how the "conclusion" follows from the observations recorded or to state what assumptions have been made in the argument. It is not, indeed, uncommon to find conclusions recorded which the pupil's own work quite fails to justify. The "doing" is, in fact, unaccompanied by any honest thinking about what has been done. There is, of course, nothing in this to cause surprise. To expect exactness of thought and accuracy of expression from younger pupils is to expect the ripe fruits of scientific education from those who have but lately begun to enjoy its benefits. If these logical errors never occurred, there would be no need to spend time over teaching "scientific method." It is precisely by seizing the opportunities which such mistakes and omissions afford that the teacher can convey to the pupil valuable lessons in the logic of science.

So far as the actual experimental work is concerned, its value depends in different schools on the extent to which the pupil is encouraged to use his own eyes, to apply his powers of reasoning to the problem under consideration, and to criticise his own procedure. The work should, in fact, serve not only to develop the powers of observation and reasoning, but to inculcate "an increasing respect for precision of statement and for that form of veracity which consists in the acknowledgment of difficulties." It is quite possible for pupils to work through a set of disconnected experiments and to get little out of it beyond a certain facility in easy manipulation. Work of this kind may be as mechanical and as far removed from being really practical as anything that is done in a classroom. The necessities of the school time-table often lead to the work being broken up into the performance of a series of isolated experiments, one for each lesson period. There is, therefore, the more reason why teachers should be on their guard against the serious danger of making the single experiment the unit of teaching. The exclusion of experiments which are trivial, or of which the results are self-evident, and the occasional adoption of the plan of allowing different groups in a class to work at different though allied experiments, the results obtained by each group being available for the whole class and used in the subsequent discussion, would do much to widen the pupils' experience and give the work a seriousness and importance which it sometimes lacks.

The remarks in the two preceding paragraphs are intended to apply more particularly to the treatment of the practical work in all science subjects in the lower and middle forms. The methods appropriate to the teaching of the higher forms are, in general, much better understood, and need not now be dealt with. But the teaching of botany requires special notice, especially in view of the important position it occupies in the science work of girls' schools.

Teaching of Botany.

Considerable changes have been effected in recent years in the method and scope of botanical teaching. The time given to the purely descriptive work connected with the classification of plants in their natural orders has been greatly curtailed, and it is now common to find included in the course an experimental treatment of plant physiology and some consideration of the question of habitat. There is, too, an increasing tendency to recognise that no adequate study of botany is possible without some knowledge of the elementary facts and principles of chemistry and physics. The broader treatment which the subject now receives, and the substitution of a partially experimental for a purely descriptive method, have led to a healthier development of science teaching in many girls' schools. But the new methods have brought with them their own special difficulties, which, in most cases, still await solution. It is rare, for example, to find the experimental work on plant physiology really well done, and the possibilities of the school garden as an adjunct to the laboratory are insufficiently realised by teachers of botany.

Though in connection with this subject it is possible to record a general tendency in the right direction, and in a fair number of instances a real advance, it is still the case that in too many schools botany is regarded somewhat in the light of an accomplishment, making no very serious demands on the pupils' intelligence and requiring little more by way of equipment than a classroom and a bunch of flowers.

In conclusion, it may be stated that if attention has been deliberately directed in some of the foregoing paragraphs to certain existing defects in the teaching of science, this is due to no failure to recognise the excellence of the work which in many secondary schools is being done under the guidance of skilled and experienced teachers.

THE SCIENCE MUSEUM AND THE GEOLOGICAL MUSEUM.[1]

THE report of the Departmental Committee on the Science Museum and the Geological Museum was published a few days ago. The committee was appointed in March, 1910, and its terms of reference were:—"To consider and report upon various questions in regard to the present condition and the future development of the valuable collections comprised in the Board's Science

[1] Report of the Departmental Committee on the Science Museum and the Geological Museum. Cd. 552. (London: Wyman & Sons, Ltd. Price 3*d*.

Museum at South Kensington and Geological Museum in Jermyn Street. In particular the committee are asked to advise (*a*) as to the precise educational and other purposes which the collections can best serve in the national interests; (*b*) as to the lines on which the collections should be arranged and developed, and possibly modified, so as more effectively to fulfil these purposes; and (*c*) as to the special characteristics which should be possessed by the new buildings which it is hoped will shortly be erected on the South Kensington site to house these collections, so as to enable the latter to be classified and exhibited in the manner most fitted to accomplish the purposes they are intended to fulfil."

The members of the committee were:—Sir Hugh Bell, Bart., chairman; Dr. J. J. Dobbie, F.R.S.; Sir Archibald Geikie, K.C.B., F.R.S.; Dr. R. T. Glazebrook, C.B., F.R.S.; Mr. Andrew Laing; the Hon. Sir Schomberg McDonnell, K.C.B., C.V.O.; Sir William Ramsay, K.C.B., F.R.S.; Prof. W. Ripper; Sir W. H. White, K.C.B., F.R.S.; Mr. F. G. Ogilvie, C.B., secretary.

The completion of the report is deferred, as the committee is unable to deal in detail with that part of the terms of reference which concerns the adaptation of the general plan of the new buildings to the requirements of classification and exhibition of the collections, until the boundaries of the site are determined. The committee therefore reserves for later consideration and report, when definite information on this point is available, those characteristics of the buildings that will be governed in large measure by special features of the particular site. In the present report the committee sets out the nature, aims, and uses of the collections upon which it proposes to base later recommendations as to the new buildings.

We print below parts of the concluding sections of the report of particular interest.

The Geological Survey Offices and the Museum of Practical Geology.

The Geological Survey Offices and Library and the Museum of Practical Geology are now cramped by the limitations of the building in Jermyn Street. These institutions, which form parts of a connected whole, and must be kept together, should be grouped, as at present, in a single building. We are convinced that if the necessary space can be allotted at South Kensington, it would be of great advantage to have that building erected as part of the general scheme there. The collections in the Science Museum represent the general principles of geology and geography by examples selected from all regions of the world—the stratigraphical collections in the Jermyn Street Museum deal specially with the geology of the British Isles (see Appendix iv., p. 30). If these two were brought together they would provide the basis of a collection that would be complete as regards stratigraphical and economic geology. Such a collection in the new buildings, with the systematic collection of minerals and the palæontological collections arranged according to their natural affinities in the British Museum (Natural History), would represent at a single centre the whole field of geological science.

In the event of the removal of the Museum of Practical Geology from its present site, more extended accommodation must be provided for the exhibited specimens. As matters stand now—to refer to one only of the activities of the Geological Survey—the economic collections, which are arranged with special reference to the requirements of the practical man and of the technological student, cannot be properly developed unless more ample galleries are available for them.

Accommodation Required for the Two Museums.

In dealing with the question of the accommodation that would be required in the new buildings, we must consider both the immediate requirements and the provision to be made for probable future expansion of the collections.

So far as the more immediate needs are concerned, we have prepared an estimate of the minimum floor space which, in our judgment, is necessary for exhibition galleries, offices, workshops, store-rooms, and demonstration rooms, or other meeting rooms, all properly lit. In this estimate we have assumed that there would be further store accommodation suitable for safe-keeping of objects, although not for their examination. The figures, which are given in Appendix vi. (see p. 32), bring out the following totals:—

Science Museum: Total floor space required in the immediate future, *exclusive* of entrance halls, staircases, lavatories, cloakrooms, and reserve stores, and *in addition to* 16,500 square feet already provided in permanent buildings, 300,000 square feet.

Museum of Practical Geology and offices of the Geological Survey: Total floor space required in the immediate future, *exclusive* of entrance hall, staircases, lavatories, and cloakrooms, and reserve stores, 60,000 square feet.

Buildings on this scale would provide for such developments as we can now foresee; we think it likely that they would be well utilised within the next ten years, or even in the course of a shorter period, if active steps were taken to make good the deficiencies of the existing collections. At the same time, the buildings could be designed so as to facilitate arrangements for meeting the possible requirements of a more distant future, and whatever space may be set free from time to time by revision of the collections, the building scheme adopted now should provide for ultimate extension of the floor space beyond the area we have stated. With this matter we shall deal further in a later report when we can discuss it with full knowledge of the site available.

General Statement.

In most of the departments of science and its applications, the museums on which we have been asked to report contain much that is of great historical interest and value. They are rich in specimens, instruments, machines, and models, selected and exhibited in such a manner as to repay systematic examination by the student. They have shown what skilful museum exposition can do to promote an intelligent appreciation of the leading facts and principles of science and of the ways in which invention has applied these to the furtherance of the industrial welfare of the world. In many sections, however, the collections are now far below the standard which it is clear they ought to reach in these matters, and their proper organisation is impossible in the existing accommodation. When suitable buildings are provided on the scale we have indicated, there will be full opportunity and encouragement for working up all the departments, and more frequent gifts and loans will doubtless quickly fill many of the gaps that are now obvious. Some gaps, indeed, would be filled at once by objects which the governors of the Imperial College of Science and Technology are prepared to present to the museum.

In other departments of knowledge, the British Museum and the Victoria and Albert Museum have set a high standard for the national provision of museum facilities. In the domain of science, the requirements of most of the branches of natural history are already admirably provided for at South Kensington in the Natural History Museum. In no way overlapping or duplicating the functions of these great institutions, but representing aspects of human activity which lie outside their scope, not less ample provision is necessary for those departments of knowledge, invention, and discovery the needs of which have been brought so vividly before us in our inquiry, and we are of opinion that no scheme for a national science museum can be regarded as satisfactory unless it provides the buildings necessary for affording to science and the industries all the assistance a museum can give. A science museum in which all branches of physical science, pure and applied, and the scientific and economic work of the Geological Survey, shall be adequately illustrated in close proximity to the other great museums at South Kensington will, we believe, be of incalculable benefit alike to intellectual progress and to industrial development, and will be recognised as an institution of which the country may well be proud.

TRAVELLING AT HIGH SPEEDS ON THE SURFACE OF THE EARTH AND ABOVE IT.[1]

"The Spirit of the time shall teach me Speed."—*King John.*

THERE are few things so important to man from a material point of view as the power of locomotion; seeing, therefore, that in this respect he is far less well endowed by nature than many, if not most, living creatures, it is no wonder that he has striven from the earliest times to overcome his inferiority by means of mechanical devices. The marvellous results of these unceasing attempts which to-day we enjoy, or, as some people would prefer to say, "take advantage of," are accepted by most of us as a mere matter of course, and we are further apt to assume that the progress which has been so marked during the last century, and particularly in recent years, will continue indefinitely. Now, quite apart from mere locomotion, the question of speed is one of great scientific interest, and, more than this, it is the real test of the power of locomotion. This is not a mere accident, but has its root in something far deeper. The desire for speed is a quality inherent in man, and is doubtless a primordial instinct, the reason for which we see in all other animals, being derived from prehistoric ages, when speed was a necessity of life to enable the weak to escape from the strong and to enable the strong to prey upon the weak, and man depended, just as the animals in prehistoric times, for his life on his fleetness and speed of motion.

From what few and somewhat uncertain records we have of the achievements of man in running in the ancient sports, it does not seem there is very much difference between his powers then and in modern times. As to modern times, we find that for the short distance of 100 yards, and for the longer distance of a mile, the records of twenty-five years ago still stand, notwithstanding the strenuous efforts made to improve upon them on many scores of occasions each subsequent year. Thus we have for the former the record of E. Donnovan in 1886, 21·3 miles an hour, and in the same year the record of W. G. George for the mile, 14·2 miles an hour, which have never been beaten; while for one distance, that of 200 yards, the record of Sewards in 1847, or sixty-four years ago, still stands. In fact, a study of all the records of twenty-five distances shows that several of them remain unbroken after comparatively long periods, viz. from a quarter to half a century.

Thus, so far as his own unaided powers of locomotion are concerned, man may be considered, for all practical purposes, to have reached long ago the limit of speed possibility. From earliest times, however, he has brought the muscular effort of other animals into his service, and has devoted his intellect towards improving their speed for his own uses. You will see graphically recorded in Fig. 1 the speeds of all the Derby winners from the year 1856, *i.e.* for more than half a century. The average speed, which may be taken as somewhere above 30 miles an hour, has doubtless slightly increased, but it will be seen from the dotted line which has been drawn at the top of the maximum speeds what comparatively little increase has been obtained for an expenditure of the many millions represented directly and indirectly in the training and breeding of these horses, and it may be reasonably assumed that here again the limit has been reached for the fleetest animal, by the aid of which man can increase his speed of locomotion by using muscular power other than his own.

What, then, are the physical reasons for this limitation? It is not due to the chief cause, which we shall see later puts a practical limit to very high speeds in mechanical locomotion, namely, the resistance of the atmosphere. Neither is it due to the effective work done in movement, since with a body moving along a level plain, *i.e.* at a constant distance from the earth's centre, this effective work is nil. To understand the matter we must study the nature of animal locomotion. The surface of the earth is rough, sliding along it being obviously out of the question; nature has made provision for animal movement as follows:—one part of the body first rests on the ground, another part supported by this is advanced, being raised clear of the ground, to rest in turn upon the ground and serve in turn as a support, so that the part behind may be raised and advanced to a fresh position. In man and other animals the feet form the points of support for this process; but the same method of locomotion is employed by creatures without feet, which have to crawl or glide, such as snakes or worms.

This process, whether with animals or reptiles, as you will see, involves in the raising of the body an expenditure of work which is not recovered, and further an expenditure of work in stopping and starting some portion of the body in its movements. My assistant now walks in front of the blackboard holding a piece of chalk level with his head, and you will see the rising and falling motion. I have prepared a wooden model to represent the action of his legs, and you will see that these legs, being equal to his in length, produce almost exactly the same curve underneath, so that you have a complete explanation of this movement, viz. the rotation of the hip about the ankle as a pivot. There is a third case of loss, namely,

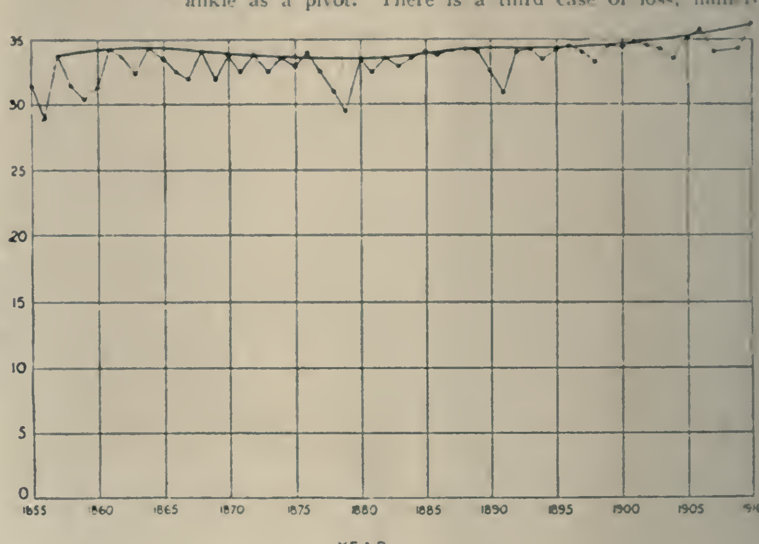


FIG. 1.—Derby Winners for 55 years.

the energy involved in swinging the legs. About thirty years ago the distinguished French professor, Marey, actually investigated the loss involved from each of these three causes, and I have on the wall a diagram in which you will see all three given graphically. The number of steps per minute, you will notice, increases until a pace is reached when it becomes painful to walk faster, and you will also notice from the diagram that at about ninety steps per minute the gait changes to a run, that is to say, a springing action takes place, the hind foot leaving the ground before the front is put down upon it.

I have another diagram showing how the length of stride at first increases with the pace, and afterwards begins to fall off before the walking breaks into a run. The reason why a man or an animal changes his pace at this point is obvious, and it is because a faster speed is possible with a less effort. As the speed of running is increased the total effort becomes greater, but the three elements shown on the diagram are differently divided; the rise and fall element is less, but the work done in swinging the legs is more, while the chief element, in the muscular effort expended, is the loss of energy involved in stopping and starting as each spring reaches a maximum. Time does not permit me to pursue this interesting subject further except to point out that exactly

[1] Discourse delivered at the Royal Institution on Friday, March 31, by Prof. H. S. Hele-Shaw, F.R.S.

similar causes operate in the natural locomotion of other animals which move on legs.

We therefore now know that the limit of speed is controlled by two factors:—

(1) Physical endurance, owing to the expenditure of work occurring at an increasing rate as the speed is increased.

(2) The physical impossibility of giving a reciprocating movement to the legs quicker than a certain limited period of time.

I have prepared a chart, Fig. 2, which shows the maximum recorded velocities of man's progression in walking and running. The speeds are set up as vertical ordinates, and the abscissæ represent the distances over which the respective speeds were maintained. It will be seen that the maximum speed of walking is about 9 miles an hour for a short distance, but when the long distance of 100 miles is covered, the quickest rate recorded falls to $5\frac{1}{2}$ miles an hour. For running, the quickest speed which I have mentioned, viz. $21\frac{1}{2}$ miles an hour for 100 yards, falls to $7\frac{1}{2}$ miles an hour as the average speed for a distance of 100 miles.

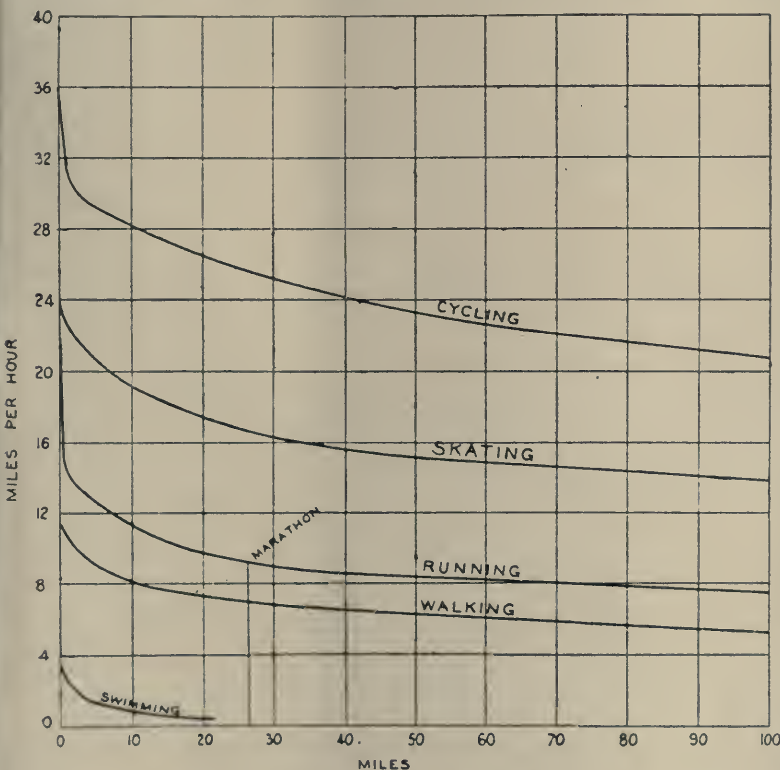


FIG. 2.—Speed Records for Human Muscular Effort.

We do not know the speed of the original historical run from Marathon to Athens, but we do know that Dorando ran the modern Marathon from Windsor Castle to the Stadium at Shepherd's Bush, a distance of 26 miles 385 yards in (to be exact) 2h. 55m. 18 2-5s., or at the rate of 9 miles per hour, which, you see, fits very well on our curve.

We may notice in passing that in walking fast and starting to run the arms swing in time with the opposite leg, as in the modern picture on the diagram exhibited. In the picture, however, copied on the same diagram from an ancient Greek vase, although the attitude of the legs is the same, it might appear at first sight as if the arms were swinging in the contrary way. As a matter of fact, a closer examination shows that in all the figures on the vase the arms are in the same position, although the legs are in different phases. This seems to indicate that the arms of a Greek runner were held in a fixed position as shown, and, from the position of the hands, with the evident intention of cutting the wind. If this is true, it indicates that even then it was clearly recognised that if there was any effect of the wind it was just as important behind as in front, a matter I shall have to allude to hereafter.

What man can do by his muscular effort in the water is shown by the small curve in the corner. The greatest distance shown (Fig. 2) is about 21 miles by Captain Webb at about 1 mile per hour, although for a short distance it will be seen that a man can swim at about 4 miles per hour. I do not put in flying, because man has not yet flown by his own muscular effort, and flying men to-day are using engines of from 20 horse-power to 100 horse-power, *i.e.* from 200 to 1000 *man-power*. Gliding *per se* is no more than falling through the air (more or less) gradually, as in a parachute.

Before proceeding to see what man has done to increase his powers of purely muscular locomotion by means of mechanical devices, we will study the details of locomotion in the other animals. We are able to do this by the method of Mr. Muybridge, since developed in the invention of the kinematograph, and which was explained by Mr. Muybridge for the first time in this country about thirty years ago in a lecture in this hall.

Take, first, the galloping horse. The lantern diagram shows clearly the various phases in the action of a horse, and shows how the animal is not only able to attain its high speed by its length of stride, but by doing what man cannot do to the same extent—drawing up its body and in springing forward, using alternately its fore and hind feet, so as to get a stride which no two-footed creature could attain on the level ground. I may point out that the kangaroo, though using only two legs, makes effective use of its tail in the spring. The horse springs clear of the ground off its forefeet, only you will notice that it uses both its fore and hind legs as the spokes of a wheel on which it rolls when walking (exactly as man does), though it rolls and springs alternately in galloping. The same kind of diagram could be constructed for the effort exerted at different speeds by the horse, as has been produced by Marey for the man, only the distribution of energy would probably be very different.

Turning next to other animals, it is interesting to observe that a greyhound gets its high speed in proportion to its size owing to the great flexibility of its long body, which enables it to draw its hind legs forward each time for the next bound, and also bound forward both from its fore and hind legs. The other animals in galloping have each the same general kind of movement, although the deer, curiously enough, only bounds from its hind legs, and differs in this respect from the horse; and also it will be noticed the want of flexibility in the body of an animal may be one of the causes of its relatively slow speed. But whether it be man, horse, dog, or any other animal, the same characteristic is found, namely, that locomotion, apart from the bounding action, takes place by a sort of rolling action on the ground. The idea which had persisted since the delineation of horses in Assyrian and Egyptian pictures, that both the fore or both the hind legs are put on the ground simultaneously, is thus exploded. As Mr. Muybridge truly said: "When during a gallop, the fore and hind legs are severally and consecutively thrust forwards and backwards to their fullest extent, their comparative inaction may create in the mind of the careless observer an impression of indistinct outlines; these successive appearances were probably combined by the earliest sculptors and painters, and with grotesque exaggeration adopted as the solitary position to illustrate great speed." As a matter of fact, each leg in turn, as it rests on the

ground, stops for a moment just as much as in the forward position above mentioned, and if you watch a dog galloping you can see quite clearly the rolling stroke action I have mentioned.

With the above facts in mind, we can understand exactly the limitations to animal locomotion. In the words of Mr. Muybridge:—"When the body of an animal is being carried forward with uniform motion, the limbs in their relation to it have alternately a progressive and a retrogressive action, their various portions accelerating in comparative speed and repose as they extend downwards to the feet, which are subjected to successive changes from a condition of absolute rest, to a varying increased velocity in comparison with that of the body." Hence all animal locomotion absolutely lacks that continuity of movement, the production of which we shall see is the distinguishing feature and the direct cause of the high speeds attained in mechanical locomotion.

The exchange of the intermittent movement of nature for one having the desired continuity of movement has been effected by means of what is possibly the greatest and yet the simplest of all human inventions, namely, the wheel. The wheel was made and used probably thousands of years before man learnt to replace muscular effort by that of steam and the other forces of nature, the origin of the wheel being absolutely lost in antiquity.

From the models which I now show will be noticed the way in which the wheel acts and how it overcomes the defect of animal locomotion, giving a rotary and continuous movement instead of a reciprocating and variable one. At one and the same time the wheel, therefore, does away with the three causes of loss shown in the diagram as occurring with animal locomotion. The mere use of the wheel has enabled man himself, by his own muscular effort, enormously to increase his individual power of locomotion. The top curve on Fig. 2 shows, in comparison with the other curves of walking and running, his unpaced records on a bicycle, in using which it will be realised that all three causes of loss which occur in running and walking are obviated. You will notice a similar difference in speed as the distance varies to that which is made evident in the curves for walking and running. For the distance of 100 miles the average speed is thus only 21 miles an hour, while that for $\frac{1}{4}$ mile is more than 35 miles an hour. In view of the results shown by the curve, it is not surprising that the bicycle has entered largely into the conditions of modern life. I am not able to give you any exact figures of the quantity of bicycles turned out each year in this country, but I can tell you that in the Post Office alone there are now 12,000 bicycles employed, and their number is always on the increase; the distance covered on them by men and boys in the year is more than 120,000,000 miles

I have not dealt with *paced* bicycle records, as such are not the result of muscular effort, but of being pushed along by the current of wind which follows up the pacing machine such as occurs when a man on a "push" bicycle is paced by a motor vehicle. In a record first set up in America for 60 miles an hour on a bicycle, a man was paced by a locomotive engine, running at 60 miles an hour along a special track; the rider was nearly killed when he tried to drop behind, owing to the whirlwind which was being dragged along by the engine; ultimately his life was saved by his being lifted bodily off his bicycle on to the locomotive. There is no record as to what became of the bicycle.

Curiously enough, records for ice skating and roller skating are almost the same, and far below that on the bicycle, which I think proves distinctly that the reciprocating movement of the limbs limits man's powers, whether he is sliding on the ice or using wheels as with roller skates. This is so, notwithstanding that he carries along with him when on a bicycle the extra weight of the bicycle, but the reciprocating movement of his legs is so slow, owing to the gearing up of the driving wheel, as to give him the material advantage shown by the respective curves. Further, in skating, there is no doubt that the movement of his limbs entails a certain amount of rising and falling, as well as reciprocating motion and consequent loss which occurs in running.

Now, in theory, the wheel is perfect, and in the case of a perfectly hard, circular wheel, rolling on a perfectly hard track, there should be no resistance. This you can well

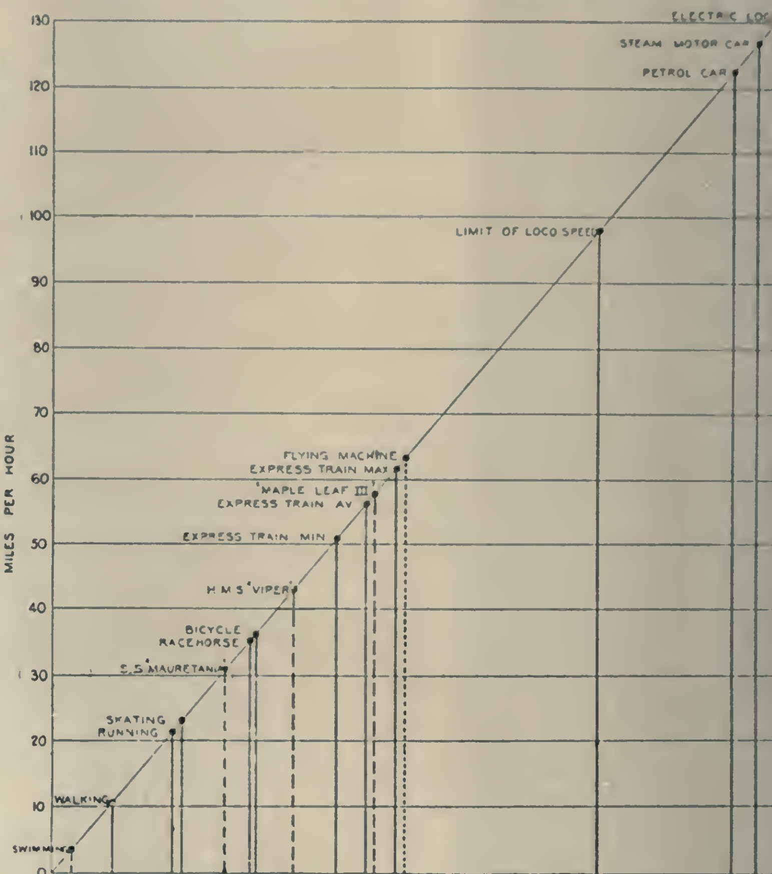


FIG. 3.—Graphical Table of Maximum Speeds.

imagine from the lantern model which I now show in operation. In this there is no appreciable resistance, but it is just in this direction that the wheel has defects unknown to nature's methods, since men and animals move upon the ankle joint in a quite superior way to the rolling of an ordinary wheel. In passing I may remark that the more man improves the roads, and the higher his standard of locomotion becomes, the more will he feel the need of a mechanical walking machine (it will be a *walking* machine, though possibly moving at 20 miles per hour) to progress over parts of the earth where roads do not exist, or are still in an evil condition. The better his mechanical appliances for producing such a walking machine, the sooner will this come about, as this is really a vital factor in the solution of the problem. No wheel, however, is quite hard and round, and no road is quite hard and smooth, and there is always an arc of contact, more or less appreciable, which causes a loss, since rubbing

takes place instead of true rolling, as shown in the next lantern slide. The next lantern working model I show illustrates the other effect, in which the wheel meets obstacles and is deflected by them from its course, giving exactly the same kind of loss which I showed you takes place with a man in walking, and which is made apparent by making the car write its own record on a piece of smoked glass, exactly as my assistant wrote his record of rise and fall on the blackboard.

Thus there are two ways in which the wheel can be improved :—

(1) Is by perfecting the wheel and hardening the track—and that is the secret of the development of the railway system.

(2) The other is by causing the obstacle to be absorbed in the tyre of the wheel—that is the real secret of the success of the pneumatic tyre.

The working model now on the screen illustrates the latter point, and shows at once how the three causes of resistance to animal locomotion are overcome.

To-day we can replace the muscular energy of man by almost unlimited mechanical power, and Fig. 3 is a comparative speed chart which I have prepared and which indicates the enormous advance in the speed record which has been made over the best unaided muscular efforts of any animal. It is curious to see that the highest speed ever attained on a railway is closely approached by that obtained with motor vehicles. The records for the latter are as follows :—

A Darracq car of 200 horse-power has done 122½ miles an hour for 2 miles. A Fiat car, driven by Nazarro at Brooklands, 126 miles an hour. A Stanley steam car, 127 miles an hour, and a Benz car has done 127½ miles an hour.

The maximum recorded speeds of a railway were on the experimental line of Messrs. Siemens, on the Berlin-Zossen High Speed Railway, where a speed of rather more than 130 miles an hour was attained. The electric current employed was 10,000 volts, 400 horse-power motors being used. On the Marienfel-Zossen experimental line, the speed attained with 250 horse-power was apparently rather less, though in that locomotive four motors were employed, the current being, as in the other case, 10,000 volts. The lantern diagrams are a picture of the vehicles actually employed, and of the track on which the experiments were made. As a set-off against the sober engineering pictures, I show a picture taken from an American motor journal, illustrating a motor vehicle and locomotive at top speed, the former passing on a level crossing in front of the latter.

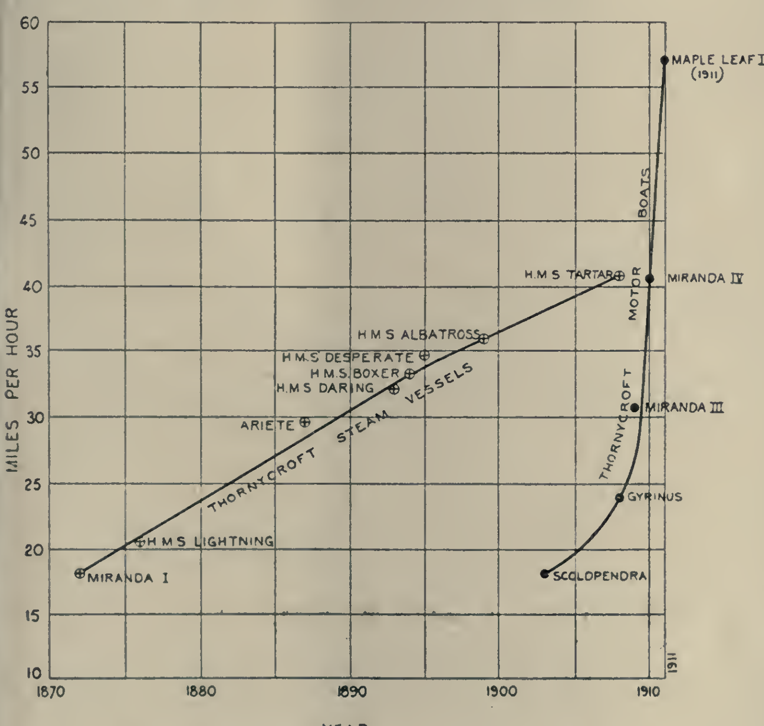


Fig. 4.—Speed Records for Thornycroft Warships and Motor Boats.

The foregoing are the record speeds so far obtained of mechanical locomotion, and it will be interesting to see what are the record speeds attained in the other elements. Until the other day, as Mr. Parsons told us in his lecture, the speed on water which has never been exceeded was that of the ill-fated turbine boats, *Viper* and *Cobra*, of about 43 miles an hour. The ship which at present holds the record for speed is the torpedo destroyer *Tartar*, built by Messrs. John Thornycroft, this, under Admiralty tests, giving a speed of 41 miles an hour.

The diagram, Fig. 4, shows in an interesting manner what the progress in speed has been for this class of boats during the last few years, and may be taken as typical, and about which curves Sir John Thornycroft writes as follows :—

"I do not think the curve would be materially altered if vessels of other builders were brought in, although there would naturally be more points on it."

I am able, however, to give you the results to-night of something which has altogether put in the shade even the speeds of the two first-mentioned boats. This has been attained by a boat which, though corresponding in some respects with previous hydroplane boats, has been designed by Sir John Thornycroft to possess a certain amount of seaworthiness. The rate of progress in the increasing speeds in this class of boat is shown on a separate curve, Fig. 4, from which you will see that the celebrated *Miranda* held as a hydroplane the record with the *Tartar* for speed, the *Ursula* also holding the record of about the same speed as a motor-boat. Only a few days ago, however, the new boat *Maple Leaf III.* has attained the extraordinary speed of nearly 50 knots, that is to say, a speed approaching 60 miles an hour, using 600 horse-power to effect this speed. To use a vulgar expression, this certainly smashes all previous records for speed. I do not pretend to give exact figures in this case, because such have not been officially taken, but the statement is probably on the low side as the boat has not been yet properly tuned up. You will see one remarkable thing from the curve, namely, that the rate of progress has been so rapid in this class of boat, and the curve rises so steeply, that in about three months' time there is due from Sir John Thornycroft a boat which will travel at about 100 miles an hour. I am afraid, however, it would not be fair to press this graphical argument quite so far.

Through the kindness of Sir John Thornycroft, and Mr. Edgar, the owner of the *Maple Leaf*, I am able to show both the *Miranda* and the *Maple Leaf III.* The latter, you will see, is travelling at such an extraordinary rate that the water which is lifted up does not fall to the surface again until the boat itself has travelled several lengths away. You may be interested to see a model of this last boat, which has been kindly prepared for me to show to-night, as well as the *Tartar* and *Miranda*. You will notice the form of the *Maple Leaf III.* is that of a steeped hydroplane, which in a modified form was first suggested by Mr. Ramus many years ago; it is the secret of placing the weight, and also the development of light engines giving large horse-power, which has enabled the dream of Mr. Ramus to be fulfilled.

Turning to the last of the three elements, namely, air, it was my intention to have dealt with it at greater length than I now find it is possible to do, but, thanks to the

daily Press and illustrated journals, this subject is as fresh in the minds of everybody as it is familiar. It is not necessary in this room to remark that the wild talk of almost incredible speeds has very little foundation. Bodies move quickly enough in the air, and very often far too quickly, but what is generally overlooked is that the difficulty of the problem lies in the matter of supporting the body in the air rather than moving through it, a problem which is very much simpler for land and water. The human body itself, while of about equal specific gravity with water, is about 800 times as heavy as air, and probably, taken in conjunction with the motor and aeroplane, the weight which has to be supported is several thousand times as heavy relatively to the air which it displaces. Inasmuch as the support of the air necessitates the use of an inclined plane and a corresponding expenditure of energy, the speeds made horizontally and independently of the wind have, at the present time, barely exceeded half the record speeds made on wheel vehicles. As a matter of fact, only the other day the record for passenger flight was broken by M. Nieuport at Mourmelon, when he flew with two passengers for 1h. 4m. 58 1-5s., and covered 68·35 miles at an average speed of 63 miles per hour. It is difficult to say exactly what the true record speed at present is round a course, but we may safely take it as probably under 70 miles an hour, the record being, so far as I have been able to ascertain, by M. Nieuport on March 9 this year at Chalons—68 miles 168 yards in the hour.

We now see the relative position of the record speeds in the three elements on our speed chart, Fig. 3, and it is obvious that while on land the speed has been far exceeded of the fastest animal, on water it has probably only recently surpassed that speed, while in the air, in all probability, it is still considerably below it. We must not, however, from this argue that flying speeds will for safe flying machines rise so far beyond that of birds as land locomotion has risen above the speed of animals, for it looks as if the speed records on land would be at least equal for some time, if not greater, than that possible with safety in the air. At the same time, there is no doubt that speed is the one great factor of safety in flying, and aërial speed records are sure to go on rising year by year, but time does not permit me to pursue this subject further to-night.

Instead of vague surmises as to what may be done in the future, let us spend a few minutes looking into the question of these limits.

The two chief things on which the limit of speed in locomotion will depend are:—

(1) The motive power available.

(2) The resistance, and the manner in which those resistances operate.

But inasmuch as we are not merely considering the human body as a projectile, we do not take into account such speeds as have been attained by man in such ways as, for instance, in a high dive, say, of nearly 100 miles an hour, or even the thrilling descents such as are made in a bobsleigh. We must really consider speeds which can be made with safety; and there are two further questions which arise:—

(1) Knowledge as to possible obstacles, coupled with a power of safely stopping within the distance to which our knowledge extends, *i.e.* signalling and brakes.

(2) Vibration.

These two latter really limit conditions of high speed for practical travelling.

In daily life, the limiting conditions of speed in travelling depend largely on the distance in which we can safely come to rest. As the population increases and there is less room for everybody, the question of brake-power becomes more and more important, and with it, of course, the power of starting from rest quickly, or, to put it in scientific words, the power of rapidly effecting both positive and negative acceleration. We are very differently constructed from the particles of air in which we live, and do not yet travel as fast, but fortunately, as yet, we are not quite so crowded, since, according to Lord Kelvin, they move about amongst each other at the ordinary atmospheric temperature and pressure at an average speed of 1800 miles an hour, and they cannot avoid fewer than five thousand million collisions in every second. As you see in the streets, and as I shall show you with regard to suburban traffic, high speed is becoming more and more a question of starting and stopping rapidly. I remember in the early days of cycle racing, in order to lighten the machine, the racing men had no brake, until they found what is now well recognised—that the speed at which you can travel depends upon the safe distance in which you can stop. I can illustrate this by dropping an egg from the dome of this building, which I can do without causing it any injury, even when it is travelling at 30 miles an hour, if I have proper means for bringing it to rest. I also drop a wineglass from the same height, and bring it to rest quite safely.

Owing largely to the perfection of the continuous brake, the speed records obtained on several railways are from 96 to 98 miles an hour, which I have put down on the diagram, and it is possible that 100 miles an hour has been reached, and even exceeded; but this is a very different matter from the highest express running which is found really practicable. You will see on the speed chart, Fig. 3, a line indicating the average railway speeds of the fastest running (without stopping) for the fifteen

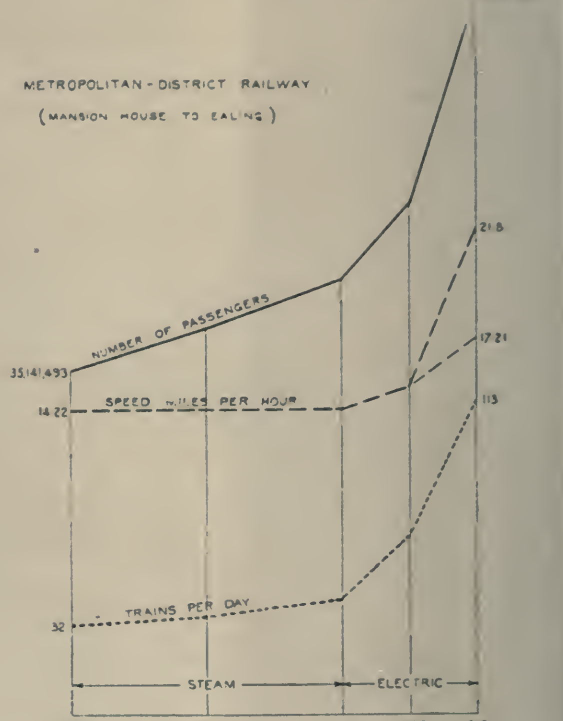


FIG. 5.

principal railways of the country. The average distance of the quick runs is 51·7 miles, and the average fastest running is 56·2 miles per hour. On either side of this line are the two fastest speeds, namely, 61½ miles per hour for 44¼ miles on the North-Eastern Railway from Darlington to York, and the lowest of these is 51 miles an hour, over the 51 miles from Victoria to Brighton on the London, Brighton and South Coast Railway. This shows how little the high speeds of all the railways of this country differ from one another, and indicates, at any rate for the present conditions, the highest speeds of travelling found suitable to our wants.

I will take as another illustration of actual travelling the case of suburban traffic; and we have only time for one example, namely, the traffic from the Mansion House to Ealing on the Metropolitan and District Railway, the details of which have been kindly provided by Mr. Blake, the superintendent of the line. Fig. 5 shows in graphical form the quickening in speed from the opening of the line in 1880 to the present time. You will notice that this increase of speed has been followed by remarkable results; the first immediate result is the possibility of a greater

number of trains, and the curve of the rise in the number of trains is shown on the diagram; but the really significant feature is the rise in the number of passengers carried, 35,000,000—72,000,000, which is the direct result of the increased facility in travelling. Now it is in such a case that the importance of the signalling and braking come to be almost pre-eminent, quite apart from the mere mechanical problem.

I may point out that the District Railway, in common with most other electric railways of this country, has what is known as a "track system of signalling," which, apart from the fact that the driver holds what is known as "the dead man's handle," which upon being released causes the train to stop, the train independently stops itself upon coming to a portion of the line not cleared by the previous train.

I have given you some examples that this country is not so far behind as we are so often told; and we have another in the fact that the District Railway has created a most beautiful system, by which the signalman is now absolutely independent of fog or darkness; he can see every train, or rather its picture, as it moves along the track in an illuminated diagram in front of him. No one could watch, as I have had the privilege of doing, the operation of this system in a signal-box without feeling certain that it must become universal in a very short time. You may like to see an actual panel from a signal-box and a view of what the interior is like with the signalman operating, instead of cumbrous levers, only a few small handles.

With regard to the question of vibration and oscillation, these are gradually being diminished as machinery is perfected, and you will see from the model illustration that

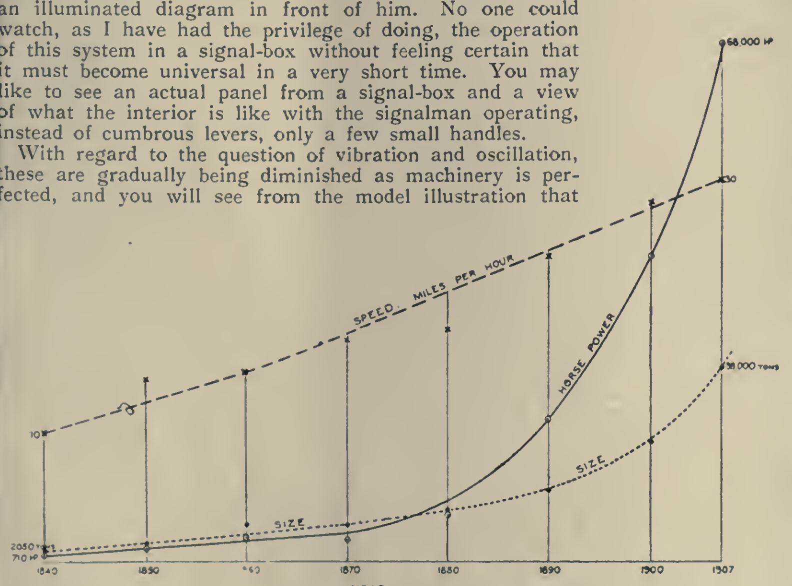


FIG. 6.—Progress in Atlantic Steamers (Cunard).

they are important, and may become very serious. They have, for instance, given Mr. Brennan much trouble in perfecting his wonderful mono-rail, with which we shall yet perhaps see every record broken; and you will remember Mr. Parsons' statement in this hall a week or two ago that an ounce out of balance on the Laval turbine represents an actual pull at the axle of no less than a ton.

There are many other features which I have not time to enter into. There is one, however, which I will briefly touch upon, as it is the secret of our safe railway travelling. I will illustrate the matter by an experiment in which a pair of wheels connected by an axle keyed firmly to both are made to run along a pair of rails. You will notice that the wheels are "coned" instead of having cylindrical rims, and it is easy to see that any movement sideways is at once corrected automatically, and within certain limits no rim at all is required for the flanges in order to keep the wheels upon the rails. The same model illustrates the important property of "super-elevation" applied to the outer rail of a curve. You will see, with proper super-elevation, the wheels run safely round this sharp curve even at a high speed. Time does not permit me to enter at any length on the question of development of power or the nature of resistance to motion. I will content myself with saying that, with regard to the former, we have already seen that the power of flight has been made possible by the invention of the small high-power internal-combustion engine, and it is to the same invention that the marvellous speeds obtained with small boats is due. We can scarcely realise what will be the result when the internal-combustion engine has been developed further for the purpose of locomotion. Our prospects of a further great advance in speed record-breaking appears to lie in this direction, and we already hear of a new car of 250 horse-power with which a speed of 140 miles per hour is confidently expected.

On water, as on land, our actual speed of travelling falls far below maximum speed records, and we do not commercially travel at much more than half the possible speed, as you see from Fig. 3, where the speed of the *Mauretania* is shown graphically. Fig. 6 is a chart of the progress of Atlantic shipping, taking the Cunard line as an example, and these curves indicate that the rate of increase of horse-power and tonnage is rising far faster than the rate of speed, and indicates how relatively highly the rate of power has increased for the gain of speed.

We have now passed briefly in review the nature of the problems which confront us in our continuous efforts to increase the safe and practical speeds of mechanical locomotion. We see that at the root of it all lies the question of artificial power and the harnessing in compact and convenient form the stored-up sources of energy in nature in order to overcome the opposing resistance, and we can realise that, although we have obviously reached the limits of animal locomotion, we are far from having reached any limitation in regard to the speed of self-propelled machines. We see that in all three forms of locomotion, earth, air, and water, the advance has been far more rapid during the last few years than ever before, and we can realise that there is yet a considerable margin by which speed of travelling could be increased as the demand for it is made; and nothing is more certain than that the demand will be made.

I began my lecture by pointing out why speed was instinctively taken as a test and a measure of locomotion from the earliest times. Shakespeare makes one of his characters say, "The spirit of the time shall teach me speed," but he might have said this of any period equally with that of King John, though never more so than of to-day, for the changes in the requirements of civilisation have only altered in detail, and speed is of as much importance as ever in the struggle of life. The probably unconscious recognition of this fact has always led question of speed to be raised as prime factors in proposals for new modes of locomotion, and it is interesting to look back only a comparatively few years to see, in raising these views, this was always the case, but how little any ideas of future possibilities were realised. When George Stevenson, backed up by a few courageous and enterprising men, was fighting the battle of the railway, and in particular trying to secure the passing of the Bill for improved communication between Liverpool and Manchester, the question of speed was the most important one raised; the opposing counsel, Mr. Harrison, spoke as follows:—"When we set out with the original prospectus, we were to gallop, I know not at what rate; I believe it was at the rate of 12 miles an hour. My learned friend, Mr. Adam, contemplated—possibly alluding to Ireland—that some of the Irish members would arrive in the waggons to a division. My learned friend says that they would go at the rate of 12 miles an hour (with the aid of the devil in the form of a locomotive, sitting as postilion on the fore horse, and an honourable member sitting behind him to stir up the fire, and keep it at full speed. But the speed at which these locomotive engines are to

go has slackened: Mr. Adam does not go faster now than 5 miles an hour. The learned serjeant (Spankie) says he should like to have 7, but he would be content to go 6. I will show he cannot go 6; and probably, for any practical purposes, I may be able to show that I can keep up with him *by the canal*. . . . Locomotive engines are liable to be operated upon by the weather. The wind will affect them; and any gale of wind which would affect the traffic on the Mersey would render it *impossible* to set off a locomotive engine either by poking the fire or keeping up the pressure of steam till the boiler was ready to burst." The committee, after hearing the arguments of Mr. Harrison, threw out the Bill for the Liverpool and Manchester Railway by a majority of 19 to 13. In order to realise that the above ideas were general, the following may be quoted from the great journal of the day, *The Quarterly*:—"What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling *twice as fast as stage coaches?* . . . . We trust that Parliament will, in all railways it may sanction, limit the speed to *eight or nine miles an hour*, which we entirely agree with Mr. Sylvester is as great as can be ventured on with safety."

Even in more recent times we see the struggle for the road locomotion question turned on one of speed, and the supporters of the new departure were unable to make any headway for many years, partly because the speed limit was put at between 3 and 4 miles an hour, that is, the limit of a walking man. A few years ago the speed of 12 miles an hour which, after a great struggle, was obtained, gave place to 20 miles an hour. You can see from the diagrams which Mr. Legros gave in a recent paper before the Institution of Mechanical Engineers, and which have been brought up to date, how the speedier self-propelled vehicle is leading to the disappearance of the horse, at any rate in London, and the difficulty which most people seem to feel is not how to get above the speed limit, but how to keep within it, and the papers show, by a daily crop of sad examples, how only too painfully easy it is not to do so.

Nothing points more clearly to what I have indicated as the basis of our instinctive desire for speed, as the fact that our measure of speed is entirely relative. Thus 60 miles an hour would be a slow speed for a motor-car on a racing track, as seen by the speeds of the motor races at Brooklands last Saturday (April 25th), but this speed, which would be even quite good along the open road to Brighton, would be considered decidedly on the high side for motoring along the Strand. Our ideas of what is slow and what is fast are largely derived from habit, and particularly from surrounding conditions and from our mode of estimation. For instance, we have been carried in this hall during the last hour with the surface of the earth round its axis a distance of about 600 miles. This speed would require a line on our speed chart about as high as the dome of the hall to represent it graphically. But if we judge the speed from observing the apparent rate of motion of the moon and stars overhead, we could never realise this. Far less could we realise by the change in the seasons the speed at which we are travelling with the earth round the sun, accomplishing a distance, as we do, of 540 million miles in 365 days, which represents, roughly, a distance of 60,000 miles per hour. We have thus travelled together, since we came into this hall, a speed of 60,000 miles. The line required on our chart for this speed would be about as high as St. Paul's Cathedral. But these speeds fall far short of those of certain heavenly bodies with which we are familiar, such as the meteors, some of which are travelling at 160,000 miles an hour, and the recent comet, which probably exceeded this speed one part of its journey round the sun; whereas the fastest speed which man has, up to the present, been able to produce, even in a projectile, amounts to between 2000 and 3000 miles an hour (the Krupp 10·7 centimetre having a velocity of 3291 metres per second, and a 6-inch Vickers, 3100 metres per second). The highest projectile speeds we have attained are thus only about one-tenth of the speed at which Jules Verne fired M. Barbicane and his friends off, in order to overcome the earth's gravity and reach the moon, since the speed he required was 12,000 yards per second, or 24,000 miles per hour. Such an idea we are quite justified in thinking absurd, but we might have been justified in thinking many of the things absurd which Jules Verne wrote about, only forty years ago, and which have since come to pass. Take "Round the World in Eighty Days." In that case it cost Phineas Fogg 19,000*l.* to take himself and his servant round the world in eighty days. A telephone inquiry of Messrs. Cook an hour or two ago elicited the fact that anyone present can start to-morrow morning and go round the world, with a servant, in less than half the above time, and for less than one-fiftieth of the above sum.

Thus though, impelled by instinct, man will ever continue to strive to increase his speeds of travelling, and with the refinement of machinery and invention doubtless succeed in doing so, it may be safely said that, notwithstanding the still increasing upward angle on some of the speed lines of the charts I have shown to-night, this rate of increase will before long begin to take place at a continually diminishing rate. Such feats as the journey from Paris to London within the hour may be regarded as quite a feasible engineering proposition in the future, though possibly a tube will be used for the purpose, without the employment of wheels, and with a modification of the pneumatic system of that great genius Brunell. We should, however, in doing this journey, be only travelling at half the rate we are actually moving at this spot round the earth's axis, while to do it at the rate we are travelling round the sun, we should only occupy a quarter of a minute. This latter speed, apart from the fact that it is getting very near the point at which meteors fuse with the friction of the earth's atmosphere, seems to be quite outside the limit of the possibilities of artificial locomotion by man, but who can tell how far we shall go towards it!

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to confer the degree of Doctor of Science, *honoris causa*, upon Dr. T. W. Richards, professor of chemistry in the University of Harvard.

On Thursday, May 11, a Grace will be offered to the Senate proposing that the Most Reverend St. C. G. A. Donaldson, D.D., of Trinity College, Lord Archbishop of Brisbane, be appointed as the representative of the University at the inaugural ceremony of the Queensland University to be held at Brisbane on June 1.

The special board for biology and geology has nominated Mr. E. S. Goodrich, fellow of Merton College, Oxford, to use the University table at Naples for one month.

Mr. A. R. Hinks will deliver a lecture on Monday, May 8, at 2.30 p.m., on "Recent Progress in the Measurement of the Earth."

On Friday, April 28, a meeting was held in Trinity College to consider the formation of a Cambridge University Eugenics Society to promote the study of heredity in its bearings on racial and social questions. The Dean of St. Paul's presided. It was resolved to form such a society, and the following officers were elected:—*President*, Prof. Seward, F.R.S.; *council*, the Rev. the President of Queens', Mr. Horace Darwin, Prof. Punnett, Mr. L. Doncaster, Mr. W. C. D. Whetham, Mr. J. M. Keynes, Mr. R. A. Fisher, Mr. C. S. Stock, Mr. R. W. Pyne, Mr. G. K. M. MacMullan, and Mr. E. P. Stapleton

OXFORD.—The Halley Lecture for 1911 will be delivered in the examination schools on Monday, May 22, at 8.30 p.m., by Prof. H. H. Turner, F.R.S., the Savilian professor of astronomy. Subject:—"The Movements of the Stars."

A COURSE of eight lectures will be delivered by Dr. W. M. Bayliss, F.R.S., on "The Mechanism of Oxidation in Plants and Animals," at University College, on Fridays at 4.30 p.m., beginning on May 5. These lectures are open free to all internal students of the University of London and to such other persons as are specially admitted.

DR. H. N. ALCOCK has been appointed to the chair of physiology in McGill University, Montreal, Canada. Dr. Alcock holds at present the post of lecturer on physiology

to the St. Mary's Hospital Medical School, and is also examiner in physiology to the Royal College of Physicians and to the National University of Ireland. He has published numerous papers on physiological subjects, and is the joint author of a text-book of experimental physiology.

MR. IVOR BACK, assistant surgeon to St. George's Hospital, lecturer on and teacher of operative surgery in the Medical School, St. George's Hospital, and Prof. D. H. Macgregor, professor of economics in the University of Leeds, have been elected to A.K. travelling fellowships. Mr. E. A. Benions, fellow and lecturer of St. John's College, Cambridge, has been elected to the fellowship rendered vacant by the resignation of Prof. I. Gollancz in December last.

THE Berlin correspondent of *The Morning Post* states that the Senate of the City of Hamburg has passed a resolution recommending that the Colonial Institute established there some years ago to train men for the Colonial Service shall be developed into an independent institution. This is regarded as the first official step in the movement to found a university in Hamburg. The city already devotes 100,000*l.* annually towards the cost of its scientific institutions, and the project evidently is to merge the latter into one university, though this word is as yet avoided.

PROF. H. E. ARMSTRONG's old students at the Central Technical College have arranged to mark their appreciation of the services he has rendered to science, industry, and education for upwards of a quarter of a century, by entertaining him at a banquet to be held at the Hotel Cecil, at 7 p.m. on Saturday, May 13. It has further been suggested that either an illuminated address or an album signed by his old students should be presented to him as a memento of the occasion. The gathering promises to be an unusually large one, and will include many of Prof. Armstrong's friends as well as old students. The chairman of the committee is Prof. W. J. Pope, F.R.S., and the vice-chairman, Mr. Maurice Solomon. Applications for tickets should be sent to one of the honorary secretaries, Mr. F. F. Renwick, Norland House, Avenue Road, Brentwood, Essex, or Mr. G. W. Tripp, 58 Little Heath, Charlton, Kent.

IT is stated in *The Pioneer Mail* that efforts are being made by the promoters of the proposed University of India and the Hindu University to amalgamate the two schemes and to work jointly rather than separately. The suggestion is that the University should be known as the University of Benares. In the beginning the University would only be an examining body like the Government universities in India, but the promoters trust that it will later on become a teaching body, and so fulfil the true ideal of university life. It is estimated that with the amalgamation of the two proposed universities the total funds available would come to 50 lakhs. It is further suggested that the King should be asked to lay the foundation of the Muslim University and the University of Benares after the Delhi Durbar.

ATTENTION has been directed already in these columns to the movement which has been inaugurated to secure the more efficient education of Europeans and Eurasians in India. An influentially signed appeal to the people of this country for a fund for this object of not less than 250,000*l.* appeared in *The Times* of May 1. An All-India Committee, representing the schools for Europeans and Eurasians established in India by the various religious organisations, has been formed, and it proposes with the fund to be raised:—(i.) to provide adequate salaries for teachers; (ii.) to increase the number of qualified teachers; (iii.) to provide facilities in India for training teachers; (iv.) to bring out qualified teachers to India until the training colleges to be founded shall have made such a course unnecessary; (v.) to provide opportunities for university education for promising students; (vi.) to improve the curricula of existing schools, especially in respect of science and manual training; (vii.) to found scholarships to assist deserving students at different stages of their education. A gift of 50,000*l.* has been received, and another gift of 5000*l.* has been contributed to the general fund in England. Further contributions may be sent to Sir Capel Wolseley, Bt., 157, 158, St. Stephen's House, Westminster, S.W., hon. treasurer of the fund.

ON April 5 the Governor of Bombay, Sir G. Clarke, laid the foundation-stone of the Central Science Institute and the Cowasjee Jehangir Hall in Bombay. In the course of his address, which was reported in *The Pioneer Mail*, the Governor said the mill owner and merchant want men accustomed to accurate thinking and capable of bringing practical consideration to bear upon realities. To both, the possessor of literary culture imperfectly assimilated is of no value, as he lacks some essential qualifications even if his literary attainments were more solid. Both look forward to the developments of the natural resources of India and the consequent creation of industries which await the diffusion of practical science among Indians. The example of Japan is frequently held up to the people of India, but the moral is not grasped. The Japanese instinctively absorbed western science and proceeded to turn it to account, and as soon as they could stand alone they showed that they could rival their European instructors in carrying on scientific progress. In India, scientific habit of thought is rare. Even in Bombay, where malaria could easily be stamped out, the proved results of harbouring the mosquito have not sufficed to carry conviction in many cases, and the spread of infection continues. Direct and indirect need of scientific training face the people of India at every turn. A patient investigator is required who will solve for India problems upon which great industries depend, problems many of which are purely Indian. A constructive power is wanted which depends upon training, that deals with forces and with facts, not with abstract speculation. The need is felt every day of the full recognition of the reign of law in the natural world and of the inexorable relations between cause and effect now widely ignored. An antidote to mere book learning is wanted, a faculty which can concentrate itself upon the practical side of the questions of the day and can discern fallacies of rhetoric, preferring action to talk and practical achievement to visions. All this and much more can be conferred upon India only by sound scientific training widely diffused.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, April 27.—Dr. H. F. Baker president, in the chair.—Lieut.-Colonel A. **Cunningham**: The number of primes of given linear forms.—H. **Hilton**: The properties of certain linear homogeneous substitutions.—W. P. **Milne**: A symmetrical method of generating cubic curves by apolar pencils.—Prof. M. J. M. **Hill**: The proofs of the properties of Riemann's surfaces discovered by Lüroth and Clebsch.—G. N. **Watson**: The solution of the homogeneous linear difference equation of the second order (second paper).—G. B. **Mathews**: A cartesian theory of complex geometrical elements of space.

Zoological Society, April 25.—Dr. S. F. Harmer, F.R.S, vice-president, in the chair.—Dr. W. **Nicoll**: Three new trematodes from reptiles, from material received from the society's prosectorium. The specimens were interesting as forming an important addition to our knowledge of the large variety of forms which inhabited the air-passages and anterior coil of the alimentary canal of reptiles and batrachians.—Dr. R. T. **Leiper**: Some parasitic nematodes from Tropical Africa. The author gave a brief description of a number of new genera. The paper was based on helminthic material he had collected during a visit to East Africa, Uganda, and the Sudan in 1907, and on material sent to him by members of the Colonial Medical Service.—Oldfield **Thomas**: Mammals collected in southern Shen-si, central China, by Mr. Malcolm Anderson, for the Duke of Bedford's exploration of eastern Asia. The region explored was in the Great Pe-ling (or Tsin-ling) range, that divides northern from southern China, many of the specimens coming from the sacred mountain Tai-pei-san, where several of the most interesting forms were obtained. Of these, by far the most striking was a new species of takin (Budorcas), readily distinguishable by its uniform golden buffy colour from the Sze-chuen species (*B. tibetanus*). In the adult of this fine animal the coloration was wholly buffy, the darkening of the ears, dorsal line, hinder back and limbs found in

B. tibetanus being absent, and there was scarcely a trace even of the dark facial patch so prominent in that animal. The new species was proposed to be called *Budorcas bedfordi*, and female No. 2190 was selected as the type. In all, the collection contained 160 specimens, referable to thirty species.

PARIS.

Academy of Sciences, April 18.—M. Armand Gautier in the chair.—The president announced the death of Jean Bosscha, correspondant in the section of physics.—Ph. **van Tieghem**: The place of the Triuraceæ in the class of Monocotyledons. The author is of opinion that this order should be suppressed, reducing the class of the Monocotyledons to two orders only.—Paul **Sabatier** and A. **Mailhe**: The catalytic esterification of the alcohols by the fatty acids: the case of formic acid. Titanium oxide is preferable to thorium oxide as a catalytic agent when working at lower temperatures, such as are required when formic acid is used. With this oxide the esterification limit of 65 per cent. is reached at 150° C., an excess of the alcohol being employed.—C. **Bratu**: The exponential integral equation.—Maurice **Fréchet**: The notion of the differential.—M. **d'Ocagne**: A nomogram for the determination of the spaces described as a function of the time whilst a ship passes from a velocity V_0 to velocity V_1.—H. **Laroso**: The problem of the cable limited in two directions.—M. **Dussaud**: New uses for low voltage bulbs. Sixteen lamps (10 volts, 1 ampere) are fixed on a rotating disc in such a manner that each lamp receives 20 volts and 1·5 ampere during a fraction of a second. With the expenditure of 30 watts a light apparently steady is obtained equivalent to 10,000 candles, or the same light as an arc consuming 6000 watts.—Guillaume **de Fontenay**: The photographic reproduction of documents by reflection.—L. **Moreau** and E. **Vinet**: The elimination of lead arsenate from grapes in the process of wine-making.—Em. **Bourquelot** and M. **Bridel**: The action of invertin on the polysaccharides derived from levulose.—P. **Sisley** and Ch. **Porcher**: The elimination of colouring matters from the animal organism. All the observations lead to the conclusion that the microbial flora takes part in the chemical processes of reduction of the azoic colouring matters.—Hermann **von Ihering**: The history of the terrestrial fauna of the Brazilian forests.—Armand **Renier**: The discovery in the Belgian Westphalian of imprints of *Calamostachys Ludwigi*.—François **Favre**: The relation between the partitions of *Oppelia* Lias.

DIARY OF SOCIETIES.

THURSDAY, MAY 4.

ROYAL SOCIETY, at 4, Election of Fellows; at 4.30.—Motor Localisation in the Brain of the Gibbon correlated with a Histological Examination: Dr. F. W. Mott, F.R.S., Dr. E. Schuster, and Prof. C. S. Sherrington, F.R.S.—Some Phenomena of Regeneration in Sycon, with a Note on the Structure of its Collar-cells: J. S. Huxley.—Cancerous Ancestry and the Incidence of Cancer in Mice: Dr. J. A. Murray.—Immunisation by means of Bacterial Endotoxins: Dr. R. T. Hewlett.—On a Method of Disintegrating Bacterial and other Organic Cells: J. E. Barnard and Dr. R. T. Hewlett.

ROYAL INSTITUTION, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

LINNEAN SOCIETY, at 8.—On John Vaughan Thompson and his Polyzoa, and on Vaunthompsonia, a Genus of Sympoda: Rev. T. R. R. Stebbing, F.R.S.—On Polytrema and some Allied Genera: Prof. Sidney J. Hickson, F.R.S.—Observations on some New and Little-known British Rhizopods: J. M. Brown.—The British Museum Collection of Blattidæ enclosed in Amber: R. Shelford.—Freshwater Algæ collected in the South Orkneys by Mr. R. N. R. Brown: Dr. F. E. Fritsch.

RÖNTGEN SOCIETY, at 8.15.—The Use of Radium in Malignant Growths: C. W. Mansell Moullin.—Rapid Radiography: Ed. S. Worrall.

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 9.—New Organic Compounds of Nitrogen: Prof. M. O. Forster, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Special Features of Alpine Scenery and the part played by Ice in their Origin: Prof. E. J. Garwood.

MONDAY, MAY 8.

ROYAL SOCIETY OF ARTS, at 8.—Rock Crystal: its Structure and Uses (Lecture II.): Dr. A. E. H. Tutton, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Foundation and Development of British Guiana from Unpublished Documents: J. A. J. de Villiers.

VICTORIA INSTITUTE, at 4.30.—A Life's Contribution to the Harmony of Christianity, Philosophy, and Science: Prof. F. F. Roget.

TUESDAY, MAY 9.

ROYAL INSTITUTION at 3.—The Institute of France: J. E. C. Bodley.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Some Saxon Bones from Folkestone: F. G. Parsons.—Further Notes on French Dolmens: A. L. Lewis.

ZOOLOGICAL SOCIETY, at 8.30.—On the Palatability of some British Insects. (Experiments made in the Society's Gardens with Arthropods (chiefly Insects) and Molluscs, and Notes on the significance of Mimetic resemblances): R. I. Pocock.—Contributions to the Morphology of the Group Neritoidea of Aspidobranch Gastropods. Part II. The Helicinidæ: Prof. G. C. Bourne, F.R.S.—On the Distribution in the Pacific of the Avian Family Megapodidæ: J. J. Lister, F.R.S.

WEDNESDAY, MAY 10.

ROYAL SOCIETY OF ARTS, at 8.—Beet Sugar Factories: Hal Williams.

GEOLOGICAL SOCIETY, at 8.—The Lower Carboniferous Succession in the North-west of England: Prof. E. J. Garwood.—Palæontological and Lithological Sequence in the Lower Carboniferous of Burrington Combe: Prof. S. H. Reynolds and Dr. A. Vaughan.

THURSDAY, MAY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On a Method of making Visible the Paths of Ionising Particles through a Gas: C. T. R. Wilson, F.R.S.—The Vertical Temperature Distribution in the Atmosphere over England, and some remarks on the General and Local Circulation: W. H. Dines, F.R.S.—On some Mineral Constituents of a Dusty Atmosphere: Prof. W. N. Hartley, F.R.S.—The Path of an Electron in Combined Radial Magnetic and Electric Fields: Dr. H. S. Allen.—On the Absolute Measurement of Light—a Proposal for an Ultimate Light Standard: Dr. R. A. Houston.—On Harmonic Expansions: Prof. A. C. Dixon, F.R.S.

ROYAL INSTITUTION, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Driving of Winding Engines by Induction Motors: H. J. S. Heather.

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of a Model of a Deformable Octahedron: G. T. Bennett.—The Scattering of Light by a Large Conducting Sphere (Second Paper): J. W. Nicholson.

FRIDAY, MAY 12.

ROYAL INSTITUTION, at 9—Biology and the Kinematograph: Prof. W. Stirling.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Some Remarks on the Nomenclature of the Veneridæ: Dr. W. H. Dall.—Description of a New Species of Conus from South Africa: G. B. Sowerby.—A Modification in the Form of a Shell (*Siphonaria Algesiræ*) apparently due to Locality: Rev. A. H. Cooke.

PHYSICAL SOCIETY, at 8.—Stream Lines Past the Elliptic Cylinder and Magnetic Interpretation: Sir George Greenhill and Col. R. E. Hippisley.—The Method of Constant Rate of Change of Flux as a Standard for Determining Magnetisation Curves of Iron: J. T. Morris and T. H. Langford.—Demonstration of an Electric Thermo Regulator: Prof. H. L. Callendar.

CONTENTS.

THURSDAY, MAY 11, 1911.

THE RADIUM TREATMENT OF DISEASE.

Radium: its Physics and Therapeutics. By Dr. D. Turner. Pp. x+86. (London: Baillière, Tindall, and Cox, 1911.) Price 5*s.* net.

THIS is a small manual suitable for medical men, giving in a concise form an account of the physical phenomena of radio-activity and the therapeutic uses of radium. For the physical part of the book the writings of Profs. Rutherford and Soddy have been largely used, and for the therapeutic chapters reference has been made to the works of Drs. Wickham, Degrais, and Dominici. In addition, the author records his own observations founded upon a five years' experience of the use of radium as a therapeutic agent. The book is illustrated by a number of plates, including portraits of Prof. and Mme. Curie as frontispiece, and portraits showing various diseases before and after treatment by radium. These include rodent ulcer, nævus, port-wine stain, warts, papilloma, and spring catarrh of the eye.

The opening chapters deal with the physics of radium. They give a concise account of the conclusions to which physicists have come—without discussion. The characteristic effects of radio-activity are enumerated, including the power of affecting photographic plates, of producing fluorescence, of ionising the air, of producing heat and various chemical changes. The alpha, beta, and gamma rays are described, the beta and gamma rays being compared with the kathode and X-rays. In dealing with the nature of the gamma rays, the author writes as follows:—

"The nature of the gamma ray is disputed; at first considered, owing to their magnetic non-deflectibility, to be a pulse or wave motion in the ether, there are now philosophers who regard them as discrete particles, but electrically neutral (positive and negative united). The question, then, is not settled. At any rate, the gamma rays are always found in company with the beta, much as the kathode ray and X-ray go together. If the gamma ray is proved to be a particle instead of a wave motion, we may have to revise our views as to the nature of the X-ray."

The author might have gone further and said that we *shall* have to revise our views as to the nature of the X-ray, for the arguments in favour of regarding gamma rays as material particles refer even more forcibly to the X-rays. The methods of containing radium for therapeutic application are of great importance, the pure salt being so valuable (1 mg. at present costing 18*l.*) that the greatest care must be taken to prevent loss. An impure salt is usually employed, being mixed with barium salts, from which it is very difficult to separate. The bromide and chloride are hygroscopic and soluble, and must be kept in an air-tight receptacle. The radium is contained, for therapeutic purposes, either in (*a*) sealed glass tubes, (*b*) ebonite capsules, or (*c*) mixed with varnish and spread out on pieces of cloth or metal.

The alpha particles are so readily absorbed that they are not available for treatment by any of these methods, even the layer of varnish in the method (*c*) being sufficient to stop the alpha particles. For the treatment of superficial conditions the more readily absorbed soft beta rays are used, a comparatively short exposure being given. For a subcutaneous condition, where the skin is to be spared, a screen of aluminium of ½ mm. thickness, or a silver screen of one-fifth of a millimetre is interposed, and a longer exposure given. For deeply-seated diseases a lead screen, varying in thickness from one-fifth to one millimetre, is interposed, and a prolonged exposure is given. In this case only the hard beta and the gamma rays will get through. When these metallic screens are used, account must be taken of the fact that the metals give out secondary rays, and that these might conceivably injure the skin. For this reason it is recommended that when a metal screen be used, a thin envelope of some non-metallic substance be placed next to the skin to cut off the secondary rays.

Radium emanation has been used therapeutically in various ways by inhalation, injection, in baths, and medicinally. Some natural waters are radio-active (Wiesbaden, Bath, &c.), and their efficacy may be in part due to this. Possibly the greater efficacy of mineral waters taken at their source, as compared with the same waters bottled and taken at home, may be explained by the decay of their radio-activity. The author refers to the present writer's method of using radium emanation enclosed in glass tubes; he points out that this use of the emanation is not, properly speaking, a use of the emanation itself, but only of its rays and of those of the active deposit, for none of the emanation can escape. It is not in any sense comparable to the use of the emanation by injection or other introduction directly into contact with the tissues. In the latter case the emanation tends to diffuse itself throughout the tissues. Wickham and Degrais have made extensive use of water rendered radio-active or actually containing dissolved radium bromide, and of emulsions of insoluble salts of radium in paraffin and vaseline for injection into tumours or beneath them, with the object of preventing their spreading deeply. Various properties of the emanation when used in any of these manners have been described. Thus it is said to increase the activity of digestive and other ferments of the body, to possess specific powers of dissolving urates; ferments which form and destroy uric acid being rendered more active by its use.

The efficacy of radium treatment is said to depend primarily on a selective destructive power, and it has been universally recognised that the rays possessing this selective action are the gamma rays and the hard beta rays, while the alpha particles are said to be universally destructive, destroying both the healthy and the diseased tissues. In the case of radium emanation or radio-active solutions, the whole of the radiation is available, and since the energy of the alpha particles is more than one hundred times as great as that of the beta and gamma together, it is clear that we are dealing here almost entirely with alpha radiation, for the effect of the beta and gamma radiation is relatively so small as to be negligible. No account is taken of this in the present book, but it

is surely of great importance; and if the special actions ascribed to radio-active solutions circulating in the body be borne out by future investigators, it is certain that we shall have to revise our assumption of the universal destructive action of the alpha particles. If we are able to do so, we may well find radium to be a far more valuable therapeutic agent than we have hitherto suspected.

After dealing with the treatment of non-malignant diseases, and with rodent ulcers which are locally malignant and yield readily to the action of radium, the true malignant growths are discussed, and a number of cases described in detail. Temporary benefit is experienced in a large proportion of the cases, the tumours become smaller, while the patient is relieved of much pain. A cure is occasionally obtained, but every case of malignant tumour that can be dealt with by the surgeon should be extirpated. Subsequent treatment with radium may be of the greatest value in destroying any cancerous cells that have escaped removal by the surgeon, and so the recurrence of the disease may be prevented.

Various rheumatic conditions have been treated with some success by radio-active earths. Comparing radium treatment with treatment by Röntgen rays, the chief difference is that the gamma rays of radium are far more penetrating than the X-rays, their effects being manifest on the tissues at a depth ten times as great as that of X-rays. Hence they are to be preferred for deep-seated affections. Radium rays are perfectly "constant" in quantity and quality, whereas X-rays are constantly varying in both these attributes. Hence a dose of radium rays can be measured with a precision that is wanting in the case of X-rays. Radium can be placed in natural cavities or buried in tumours, and left for an indefinite period, giving off its radiation all the time. The quality of the scars left after radium treatment is usually exceedingly good, and is certainly better, as a rule, than the scars left after X-ray treatment. Radium, again, is readily portable from patient to patient. The chief disadvantage of the use of radium is its extremely high price and the consequent risk of loss by breakage or accident. The chief advantage of X-rays over radium is the large area to which the X-rays can be applied.

In reviewing the present state of our knowledge of the therapeutic effects of radium, the feeling reached is that we are making our applications empirically in the hope of lighting, almost by accident, on some property of value in the cure of diseases which have hitherto baffled the physician's skill.

A. C. JORDAN.

ELEMENTARY ZOOLOGY.

An Introduction to Zoology. By Prof. R. W. Hegner. Pp. xii+350. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 8*s*. net.

THERE are some interesting distinctive features in this new introduction to zoology. Only a few types are studied (all of them Invertebrates); they are discussed so as to illustrate the principles of the science; the morphological aspect is not specially emphasised, but is coordinated with the physiological aspect (which, of course, includes the study of inter-relations and behaviour). From a mapping out of the subdivisions of the science (which admits of much improvement), the author passes to the characteristics of living organisms (where the autonomy of biology seems too easily surrendered to the mechanists), thence to the cell, and to the Protozoa. After an introduction to the Metazoa, which makes the significance of the transition admirably clear and introduces some exceedingly useful original diagrams, the book goes on to Hydra and other Cœlenterates, Unsegmented Worms, the Earthworn and Annelids, the Crayfish and Arthropods, the Honey Bee (which is admirably treated), and bees in general. Then follows a chapter on the history of zoology (entitled "Historical Zoology"), and the book ends with a terse consideration of the factors in evolution and related questions. There is a very useful bibliography, and a glossary.

The author shows a keen educative instinct (though the pemmican of the chapter on evolution is questionable); there is a marked freshness and individuality of treatment, and the assistance of a number of experts, who have read particular chapters, has secured an enviable freedom from mistakes.

Having expressed our admiration of the outlook and workmanship of Prof. Hegner's book, we may direct attention to what appear to us to be blemishes. (*a*) Since no complete physico-chemical re-description of any vital activity has as yet been given, it seems to us a great pity to give young students a prejudice in favour of mechanistic theories. (*b*) Being indifferent to the curricula of American Universities, we cannot reconcile ourselves to an introduction to zoology which practically (and advisedly, of course) ignores the Vertebrates. Especially in a book which is so praiseworthy in its recognition of the animal mind, kept by most "zoologies" at a distance, does it not seem a pity not to have included some Vertebrate with a "big brain" if only to contrast it with the bee's, which is on a different evolution tack altogether? (*c*) It is probably beyond the reach of human endeavour to write a text-book of zoology without mistakes, and it is with a full and lively sense of our own fallibility that we ask Prof. Hegner to justify his statement that an anus is present in Ctenophora. We are not very sure about the cœlom of Nemathelminthes either, but "morphology is not specially emphasised" in this book. Besides, what have first-year students to do with cœloms? (*d*) In looking up the glossary to find what "evolution" meant, we found it was "a theory of development" (see p. 291). But this definition is obviously meant to be the counterpart of that of epigenesis which is given a few lines higher up, whereas p. 291 deals with evolution in the ordinary sense. In a definition given of heredity—a very doubtful one to our thinking—a reference is given to a work in which the definition cited was within inverted commas, and obviously not that of the author of the book referred to. But excepting (*a*) and (*b*) these are small blemishes in a work which it has been a pleasure to read, and which deserves a career of much usefulness.

FOREST FIRES.

Incendies en Forêt. By A. Jacquot. Translated by C. E. C. Fischer. Pp. xv+278. (Calcutta: Superintendent Government Printing, India, 1910.) Price 14 annas, or 1*s.* 3*d.*

THE title of this book, "Incendies en Forêt," is somewhat misleading, as it is in the main a general treatise on the valuation of forest property, and forest fires are only partially treated, in so far as their occurrence necessitates a correct mode of appraisement of the damages caused by them.

The first chapter deals with French law in relation to the punishment of incendiaries, and the legal duties of forest officers. Very little is said about the important subject of the prevention of forest fires. We learn, however, that in France fire is only dreaded in the pine forests of the Landes, and in the broad-leaved forests of districts like the Maures and Esterel, where an arid climate prevails. In Provence the compulsory preventive measures are the maintenance of open rides along the borders of the forest, and the clearing away of brushwood in belts four yards wide on each side of the roads and paths throughout the forest. In the Maures and Esterel, but not elsewhere, the railway companies are obliged by law to clear, at their own expense, belts ten to fifty yards wide on both sides of the permanent way. These fire-lines are too narrow to arrest the progress of fire, but serve as bases from which counter-fires can be started.

The bulk of the book deals with the valuation of forests at all ages and of all kinds, a difficult subject, treated carefully and with great detail. The author advocates what he styles the positive mode of valuation. The value of the land itself is estimated by comparison with similar land near at hand, and not by theoretical computations of its timber-producing capacity. The standing crop of merchantable trees is valued as they would be by a timber merchant, namely, by actual measurement of their volume and the price they would fetch in the local market. Young stock, of no actual sale value, is reckoned by discounting at the moment its estimated value at the time when it would be ripe for felling.

Many interesting facts and experiments are mentioned, especially with regard to thinning, which are worth the attention of British foresters. The author shows that thinnings properly executed in coppice—a practice never attempted in England—increase the final yield 50 per cent., and amply repay the small cost of the operation. He declaims against the dense stands of mature trees, which are common in high forests in Germany, alleging that these, although they show more stems, produce a less volume of timber. Thinning is much more drastic in French pine woods than in those of Germany. Pines are light-demanding trees, and heavy thinning secures to each individual the best conditions of light and nutrition, both height and girth increments being stimulated. Moreover, the thinnings yield a considerable revenue, often surpassing in value the final crop, and as this is available early, the rate of interest on the capital at stake is materially increased. Thinning is also necessary, where wind is dreaded, as it strengthens the root systems of the trees that are left. In Germany, it is usual to remove only the dead, decaying, and suppressed stems, whereas in France some of the dominant trees, though in full vigour, are removed. It is often believed that growth in height is stimulated by dense crops, whereas it has been proved by experiments that not only does thinning increase the diameter of the trees left standing, but it also increases their actual height, and improves the form of the stem, which becomes more cylindrical, with an enlarged canopy of foliage. The importance of dense woods at the outset is acknowledged by all, as by their shade the stems are cleaned of their branches, and timber free from knots is produced; but in the later stages of growth there is no doubt of the advantage of the system of judicious repeated thinnings. For oak and beech the effect is the same as for pine.

The disastrous effects of fire upon the soil of the forest is well illustrated by the author, who also enters at some length into the part played by the forest in lessening hailstorms in its vicinity, in improving farm crops by its shelter, and in preventing disastrous floods at a distance.

The book is remarkably cheap, only 1*s.* 3*d.*, and one cannot quarrel with the frequent misprints (*Cf.* p. 17, pendunculate for pedunculate, and holme for holm), and its occasional curious phraseology. It should be of great service in India, and can be read with profit by landowners and foresters in England. It is provided with eighteen pages of useful interest tables.

LIVING MATTER AND ITS FUNCTIONS.

The Evolution and Function of Living Purposive Matter. By N. C. Macnamara. (International Scientific Series.) Pp. xi+298. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 5*s.*

THE object of this book is to trace and explain the evolution of the functions of those elements of living matter which are essential for the manifestation of purposive, instinctive, and psychical phenomena. The book is divided into two parts; in the first the evidence is given which the author believes proves the gradual evolution of purposive action in protoplasm in the various classes of the animal kingdom, in the second the soundness of these conclusions is put to the test by giving in outline the leading characteristics displayed by the Irish Celts of County Clare—a long line of individuals who lived under conditions well adapted to show the power which their inherited qualities exercised on the actions of many successive generations and on the destinies of the race.

The author believes that protoplasm, even in the lowest living forms, exhibits characteristics which indicate the possession of purposive elements, and that these undergo evolution *pari passu* with those elements which constitute the structural parts of the organism. The author holds that even among the

Protozoa the response to stimuli exhibited by their protoplasm is not simply one of reaction to external stimuli, but is of such a nature that a *purposive* function seems to be postulated, and that protoplasm, even in very lowly forms, as undoubtedly is the case in higher ones, is able to store impressions—possesses, in fact, the rudiments of a memory. From the undifferentiated condition, the next step forward is the development of a rudimentary nervous system, such as occurs in the sponges, then the development of well-marked nervous tissue, its aggregation into ganglionic masses, and eventually the formation of a definite though simple nervous system is traced through the invertebrates, and, finally, the progressive evolution of a nervous system through the vertebrates, culminating in man with his elaborate psychical processes.

Although some would hold that the response of protoplasm to external stimuli is simply one of reaction, we think that the author's view of purposive action in addition is borne out by the facts cited, and that this is inherent in protoplasm, just as the tendency to variation appears to be. With regard to the second part of the book, we are not in a position to criticise its historical accuracy, but it makes interesting reading. The emotional and instinctive qualities displayed by the Irish Celts depends, according to the author, on their hereditary characters rather than on experience and on intellectual acquirements. The book is pleasant and instructive reading, and though here and there not altogether free from error, on the whole is a simple and well-developed exposition of the subject of which it treats.

ANIMAL PSYCHOLOGY.

(1) *L'Evolution de la Mémoire.* By Henri Piéron. Pp. 360. (Paris: Ernest Flammarion, 1910.) Price 3.50 francs.

(2) *Vorlesungen über Tierpsychologie.* By Prof. Karl Camillo Schneider. Pp. xii+310. (Leipzig: W. Engelmann, 1909.) Price 8 marks.

(1) M. PIÉRON'S book is a new addition to that excellent and deservedly famous series, the "Bibliothèque de Philosophie scientifique," and is quite worthy of its place. Its subject is, to say the least, a difficult one, being dependent on the careful interpretation of vast quantities of scattered observations and researches made by students of comparative psychology during quite recent years; but M. Piéron has produced out of this material, some of which is furnished by researches of his own, a volume which is not only compact and thoroughly sound, but also readable.

In an excellent introduction, he criticises certain definitions of memory that have been held in the past, and shows by the help of numerous and interesting examples the continuity, the complete lack of hiatus, in the succession of phenomena commencing with the inorganic memory shown in viscosity, hysteresis, &c., through biological memory, heredity, adaptation, &c., to psychological memory, which is frequently alone allowed the designation memory. The presence of consciousness in psychological memory is important, but not of that essential significance which the more metaphysically-minded among the psychologists are so fond of attributing to it. This is quite clearly shown in researches on the memorising of nonsense syllables (Ebbinghaus) where the curve representing the number of repetitions necessary for completely learning series of varying lengths is found to belong to the same type, to have the same mathematical equation, as that representing monomolecular autocatalytic reactions in chemistry, viz., $\log x = Kt + b$.

The contrast, in fact, is not between subhuman and human memory, but one between memory as it is for the individual himself as he enjoys it in consciousness, and memory as it manifests itself objectively both in himself and in his fellow-man.

The author proceeds to consider the phenomena more in detail, commencing with an interesting description of the "persistances rythmiques" displayed by both plants and animals. In the case of the latter, the best examples are given by marine animals, which live on the seashore and reproduce in their organic functions the rhythm of the tides. The rhythm persists when the animals are removed to a new, non-rhythmical environment, although an observer has found that this is not the case with young individuals that have not experienced the tidal rhythm. Piéron has some interesting comments and criticisms to make on the whole problem.

There follows a clear and concise account of the modern experimental methods of research employed to investigate the processes of adaptation and the formation of habits in animals, and the important researches of Thorndike, Hobhouse, Yerkes, and others are usefully summarised. A chapter on "sensory memory," full of experimentally determined results, completes the part of the volume allotted to subhuman psychology.

The last hundred pages of the book deal with specifically human memory, and summarise in small space an enormous number of experimental investigations. The author points out that the laws of rate of learning and forgetting admit of identical mathematical expression for animals and for men, for the different forms of sensorial and motor memory, &c. The curves correspond to the same general mathematical formula, viz., $y = A/K - B^x$. The non-correspondence of memory and intelligence is noted, and pathological modifications are adequately treated. With a useful chapter on the utilisation of memory, and a conclusion, written in more speculative mood, the book ends.

(2) Prof. Schneider gives in his series of published lectures a very full and decidedly original account of the subject-matter of animal psychology. Regarding the physiological mechanism of the nervous system as capable of producing summation of stimuli only, he finds himself forced to assume an active and efficient "Psyche" to explain most of the phenomena of his science. "Die Psyche assoziiert die einzelnen Eindrücke, die dabei ihre Selbständigheit wahren (Assoziationsorgan), während das Gehirn sie sum-

miert und dabei die einzelnen in ihrer Sondernatur vernichtet (Summationsorgan)" (p. 292). Final causes are postulated. "Ohne Berücksichtigung von Finalia ist ein Verständnis auch der einfachsten Amöbenhandlung unmöglich." His account of instinct, therefore, is through and through teleological. The ends pursued are not to be explained from experience, on one hand, nor are they explicable in terms of organisation as a product of evolution. They can only be accounted for in terms of an "Allgemeinbewusstsein," or "Weltvernunft," an absolute consciousness. Kant and Hartmann are referred to more than once, nor is Hegel omitted. Those men of science to whom metaphysics is anathema, and those (a class comprising much the same people) to whom it is a *terra incognita*, will reject much of the book as unsound. For others the book will be found full of suggestions and new points of view.

WILLIAM BROWN.

SCALE MOSSES.

The Liverworts, British and Foreign. By the Right Hon. Sir Edward Fry, G.C.B., with the assistance of Agnes Fry. Pp. viii+74. (London: Witherby and Co., 1911.) Price 2*s.* 6*d.* net.

IT is a pleasure to welcome the little volume on liverworts, to which scale mosses, as well as the more familiar Thallose forms, like Marchantia, belong. Sir Edward Fry has long been known as one who takes a keen interest in mosses, and this new little book on an allied group of plants will appeal to those amateurs who like to know something at first hand of the less easily studied objects of nature. In truth, the liverworts are fascinating plants, for they stand at the parting of the ways where the higher forms branch off from the lower series of primitive groups. They are, however, not easy to study, for they need a keen eye to detect them, and they are, many of them, very difficult to identify.

The authors have done good service in giving a popular and attractive account of the family. The variety of forms, no less than the suggestive differences in their organisation, pointing as it does towards higher vegetative development, will commend the group as a whole to the attention of many who may have avoided it on account of the difficulties which have to be surmounted in making a first acquaintance with the plants composing it.

When the book is critically examined there are not unnaturally points in which one may differ from the authors. The affinity between Calobryum and Monoclea is really artificial, and they are not generally regarded as closely related. Recent work indicates that the former is more naturally placed near Haplomitrium, whilst a considerable difference of opinion exists as regards Monoclea, some considering it as near the Marchantiaceæ, others as belonging to the Jungermanniaceæ in the wider sense.

As regards the origin of elaters, probably the Riccia-Corsinia series affords a better clue than the more specialised Anthocerotaceæ, but it may perhaps be argued that this is, after all, rather a matter of opinion than of proven conclusion. We feel inclined, however, to take exception to the comparison between the stomata of the grass-like sporophyte of Anthoceros and those of the thallus of Marchantia, which belongs to the other—the gametophyte—stage in the life-history. The similarity between the two organs is very slight, and although they perform the same function the mode of origin is quite different in the two cases.

But these are small matters in a book which is written for the amateur rather than for the professed botanist, though the latter will also find it worth reading. There are a few misprints which might be corrected—one of them, Trichcolea for Trichocolea, occurs several times—when a new edition is called for. In the meantime, we can congratulate the authors on having written an interesting little book on a difficult series of plants.

REFRACTORY MATERIALS AND PRODUCTS.

Fabrication et Emploi des Matériaux et Produits réfractaires utilisés dans l'Industrie. By Prof. A. Granger. Pp. iv+378. (Paris Ch. Béranger, 1910.) Price 15 francs.

THE scientific study of firebricks, furnace blocks, crucibles, and other refractory products is one of increasing importance. The progress of metallurgy, of glass-making, of pottery—even the development of the domestic firegrate—demands scientific, as opposed to rule-of-thumb, knowledge of refractory materials and how they may be best applied to the requirements of different industries. Although many excellent refractory products are made in these islands, the scientific study of the subject as a whole has received but little attention as compared with that given to it in Germany, France, and the United States. A few years ago Dr. J. W. Mellor, of the Pottery Laboratory at Stoke-upon-Trent, endeavoured to set up a committee for the study and standardisation of firebrick and refractory materials, and his work is now being carried on, we believe, by a committee of the Iron and Steel Institute, but it appears likely that some considerable time must elapse before we have an English text-book dealing with the subject as fully and as concisely as this French work.

Mr. Granger is well known as the professor of ceramic technology in the school attached to the State porcelain works at Sèvres, and in all his works one recognises the hand of the teacher who finds it necessary to compile a text-book for his students. This is at once the strength and weakness of such a volume. With the usual logical accuracy and perspicacity of a French writer, the author gives an excellent review of his subject. He treats of every variety of refractory material, fireclays, chromite, magnesia, and aluminous products, including the newest materials prepared for electric furnace work.

The book contains a series of excellent illustrations of the various forms of machinery especially adapted for the treatment of fireclays, &c., and the chapter on kilns and methods of firing, which are of extreme

importance in practical work, is excellent. The illustrations of gas-fired kilns, on pp. 81–4, should prove of great value to the English manufacturer, who, so far, has made little use of continental improvements in methods of firing.

The chapter dealing with pyrometry and pyroscopes is also well done, and the discussion of the value of the "Seger" cone is singularly clear and accurate.

We can cordially recommend the work to all who are interested, either as manufacturers or as users of refractory materials, and it would be a still greater pleasure to note the appearance of an English work as comprehensive in scope and plan.

WILLIAM BURTON.

BACTERIOLOGY: GENERAL AND SPECIAL.

(1) *Agricultural Bacteriology, Theoretical and Practical.* By Prof. John Percival. Pp. x+408. (London: Duckworth and Co., 1910.) Price 7s. 6d. net.

(2) *A Text-Book of General Bacteriology.* By Prof. W. J. Frost and Prof. E. F. McCampbell. Pp. xvii+340. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7s. net.

(3) *Die Eisenbakterien.* By Prof. Hans Molisch. Pp. vi+83. (Jena: Gustav Fischer, 1910.) Price 5 marks.

(4) *The Sources and Modes of Infection.* By Dr. C. V. Chapin. Pp. ix+399. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 12s. 6d. net.

(1) WE have read this book with much interest. The plan of it is well conceived, and it will serve not only as a useful text-book on agricultural bacteriology, but also as an excellent introduction to general bacteriology for those who are non-medical and do not wish to specialise in the medical and pathological side of bacteriology.

In the opening chapters a general account is given of the bacteria, their physiology, morphology, and classification, and the methods employed in isolating, cultivating, and studying them. Fermentation and enzyme action are then briefly discussed, including putrefaction. Next an excellent account is given of the bacteriology of soil, of nitrification and denitrification, and of the fixation of nitrogen, and, finally, the bacteriology of manure, milk, cream, butter, and cheese is dealt with. Considerable space is rightly devoted to milk and milk products, and the subjects of the sources of bacteria in milk, the fermentations occurring in milk, the filtration, cooling, pasteurisation, and sterilisation of milk, milk and its relation to disease, milk standards, cream and cream ripening, the bacterial content, flavour, and defects of butter, and the ripening of cheese are adequately described. A final chapter is devoted to the yeasts and moulds. Throughout the book series of excellent practical exercises for the student to work out are attached to all the sections. A few errors appear which will need correcting in a future edition. The *B. lactis aërogenes* is described on p. 10 as Gram positive, on p. 275 it is correctly stated to be Gram negative; on pp. 46–7, dealing with the neutralisation of culture media, it is stated that most bacteria grow best when the medium contains 1 per cent. of free normal acid; this, however, is true only when phenolphthalein is used as an indicator, and such media are alkaline to litmus. On pp. 96–8 the term "proteose" has been substituted several times for "proteolytic enzyme," entirely obscuring the meaning, and on p. 116 "nitrogen peroxide" appears in place of "hydrogen peroxide." The book is clearly printed, and contains a number of appropriate and well-executed illustrations.

(2) The authors state that there is no work in English on the subject of general bacteriology with the exception of the translation of Fischer's "Vorlesungen," and have attempted to supply this want in the present volume. On the whole the matter is presented in a readable and accurate form. The preliminary chapters dealing with the history of bacteriology might have been somewhat extended with advantage, and the omission of any mention of Lister's work on the lactic fermentation seems unpardonable. The chapters summarising the structure and composition of the bacterial cell and the morphology and classification of the bacteria are excellent. The methods employed in bacteriology and the general physiology of the bacteria are detailed at some length, and in the final portion of the book the biology of specialised groups of bacteria are briefly described. We think the authors have succeeded in their endeavour, and have produced a book which will be of considerable service as a general introduction to bacteriology.

(3) This is a monograph on a group of micro-organisms of considerable biological and practical interest. A majority are thread-forming species, and differ essentially in this respect, and also in the fact that they form conidia, from the true bacteria. They live in waters containing iron and have the capacity of "attracting" the iron from its solution and of depositing it around them as ferric hydroxide, which stains them brownish-red in colour. Ultimately the organisms die, sink to the bottom of the water, and cause the reddish-brown colour so often seen at the bottom of streams and ponds. It has been suggested that some of the iron-ore deposits have been formed by the activity of "iron bacteria" living in the warm waters of an ancient sea. They also cause rusting of iron pipes and conduits and masses of their growth sometimes mechanically obstruct the flow of water in pipes. Prof. Molisch has collected in this monograph the descriptions of the known species; and with the attached bibliographies, illustrations, and plates, and details for their investigation, it forms a valuable survey of the group.

(4) Although this subject is dealt with in works on medicine, epidemiology, and bacteriology, and a special work on it might be considered superfluous, a perusal of its contents has convinced us that Dr. Chapin has compiled an extremely useful summary. The life of disease germs outside the body and the conveyance of infection by contact, fomites, air, food and drink, and insects, are fully considered. An im-

portant chapter deals with "carrier" cases, and considerable stress is laid on this mode of the spread of infective diseases. The limitations to the value of isolation for the prevention of the spread of infectious diseases are critically discussed, and the conclusion is reached that isolation is of far less value than was formerly believed. Bacterial and protozoal diseases are both dealt with, and full references are given to the literature.

R. T. H.

CHEMISTRY FOR MATRICULATION.

(1) *A Class-Book of Chemistry.* By G. C. Donington. Pp. xi+399. (London: Macmillan and Co., Ltd., 1911.) Price 3*s*. 6*d*.

(2) *Chemistry for Matriculation.* By Dr. G. H. Bailey and H. W. Bausor. Pp. viii+548. (London: W. B. Clive, 1910.) Price 5*s*. 6*d*.

(1) MR. DONINGTON'S volume is a very interesting attempt to combine a practical course on modern lines with a descriptive text-book. The arrangement of the matter is distinctly original and has been carefully thought out. Discussion of more abstract topics, such as the atomic theory, Avogadro's hypothesis and valency, is postponed to a late stage in the book, while no chemical formula appears until p. 283. The preference thus given to a more descriptive treatment of the science is all to the good in an introductory class-book of this kind. In the early chapters the author deals very appropriately with the physical operations and physical properties which are used in the purification and characterisation of individual substances, such as solution, crystallisation, distillation, determination of melting points and boiling points, measurement of volume and density of gases. The first topics of a definitely chemical nature to which the reader is introduced are "acids and alkalis," "neutralisation," "rusting" and "burning," "active and inactive constituents of air," "elements and compounds." It must not be supposed that this descriptive treatment involves the suppression of the quantitative aspect of chemical changes. On the contrary, the author contrives in the earlier part of the volume to introduce the pupil by the way to the fundamental quantitative facts of chemistry.

While the general arrangement of the subject-matter is excellent, it may be doubted whether the author attains his object of providing a basis for teaching by research methods. With this in view, each topic is, as far as possible, introduced by the suggestion of experiments to be carried out by the pupil, these leading up to the solution of various problems. The paragraphs, however, in which appropriate experiments are indicated are followed by an authoritative description of all the facts bearing on the question. Various experiments, for instance, relative to the nature and cause of iron rusting are suggested, and the results obtained are supposed to enable the pupil to answer such questions as "Does iron rust in dry air?" "Does water *only* cause iron to rust?" "Is the rusting of iron a chemical or a physical change?" The correct answers, however, are supplied in the descriptive paragraphs which follow, and it is plain that the replies given by the pupil under such conditions cannot be unprejudiced.

The selection of practical exercises is excellent, and the course has stood the test of actual experience. The illustrations include portraits of such pioneers as Priestley, Lavoisier, Davy, and Faraday.

A curious error is the spelling of Avogadro's name throughout as Avagadro.

(2) The second volume under review belongs to the "University Tutorial Series," and is based on Dr. Bailey's earlier work, "The New Matriculation Chemistry." The authors aim at a combination of the heuristic and didactic methods of teaching, and practical exercises for the pupil are accordingly interwoven with the text.

The book begins with an introductory course in which "special care has been devoted to the treatment of the Laws of Constant and Multiple Proportions, Avogadro's Hypothesis, and the meaning and use of Chemical Formulæ and Equations." There is much, however, in the discussion of these topics that is open to criticism. Thus, for instance, Avogadro's hypothesis is described on p. 141 as a "law," the word molecule is used in different senses without any explanation, atomic weights are tabulated and used before the idea of "equivalents" is introduced, and hydrogen is taken as the standard of atomic weights. According to the preface, the book aims at providing a course of fairly detailed study in chemistry, and yet no information is given as to practical methods of deducing atomic weights from equivalents; there is, for instance, no reference to Dulong and Petit's law.

The choice of practical exercises to be performed by the student is not always wise. Dropping a piece of sodium about the size of a pea into water, and demonstrating the low ignition point of benzoline, are experiments which in the hands of beginners might have unpleasant consequences, while such exercises as the preparation of ethylene and the conversion of yellow phosphorus into the red variety are not suitable for the matriculation student.

J. C. P.

OUR BOOK SHELF.

Trattato di Chimica Inorganica generale e applicata all' Industria. By Prof. E. Molinari. Terza edizione. Pp. xvii+924. (Milano: U. Hoepli, 1911.) Price 16 lire.

When the first edition of this work appeared in 1905 its many excellent and novel features were commended in the full review which was published in Nature of February 29 of that year. That these qualities were widely appreciated is shown by the fact that a second edition was called for within a year, and a third edition is now being issued. The present edition contains a very large amount of new matter, above 200 pages having been added to the text, fifty-six of which belong to the general introductory section, and deal with such subjects as mass-action, equilibrium, dissociation, and the phase rule. That the revision of the special section has kept pace with the march of modern industrial development is shown by the very thorough alterations which have been made

in the text, owing to the introduction of new processes, for example, under such headings as the manufacture of liquid carbon dioxide, steel, cements, superphosphates, the fixation of atmospheric nitrogen, &c.

The revision here has been thorough, and many new illustrations, mainly photographs, have been added. The older statistical data, which formed so novel a feature of an elementary treatise of this kind, have been brought up to date. It is pleasing to note that the few misstatements pointed out in the review of the first edition have been rectified. A few misprints of names still occur, *e.g.* Rooseboom for Roozeboom (p. 870), "Lothian, Bell," (as two names) for Lothian Bell (p. 876), Gulber for Guldberg (p. 127), but such misprints are more or less inevitable in view of the very large number of proper names employed, and is not a serious blemish. The work is undoubtedly written by one with a full knowledge of his subject, and will prove useful to a large public, especially to chemical students, engineers, or others interested in the later developments of inorganic chemical industry; in it theory and practice are admirably blended. W. A. D.

Dizionario di Merceologia e di Chimica applicata. by Prof. V. Villavecchia. Terza edizione. Vol. i., A–M. Pp. xii+1558. (Milan: U. Hoepli, 1911.) Price 15 lire.

THE present volume is the third edition of a dictionary of commercial articles, produced in all the various branches of applied chemistry—in the widest sense of the term—ranging from such natural products as minerals and metals, fruits and seeds, oils and fats, through all the branches of applied chemistry upward to the most refined chemical, pharmaceutical, and alimentary preparations. Each article represents a concise monograph on the subject of which it treats. In addition to the Italian synonyms, the French, German, English, and Spanish equivalents are given. Each monograph details the origin, the description, and preparation for the market of the article; it describes the commercial qualities, characters, properties, composition, the adulterants frequently found therein, the most characteristic tests for purity, and the uses of each article. Then follow statistical data, information about market values, and, finally, data concerning specifically Italian conditions, such as import duties and imposts, and references to the Italian pharmacopœia.

The reviewer has selected at random a number of subjects with which he is specially familiar, and has found the information concise, trustworthy, and ably presented. This work must perforce interest the Italian student in the first instance. The fact that the present volume of 1558 pages, from Abelmosco (musk seeds) to Mussena (Massena), appears in its third, much enlarged edition, testifies to its usefulness to the Italian reader.

Annual and Biennial Garden Plants: Their Value and Uses, with Full Instructions for their Cultivation. By A. E. Speer. Pp. xx+256. (London: John Murray, 1911.) Price 7*s.* 6*d.* net.

THERE appears to be no lull in the demand for books on gardening if one may judge from the voluminous output of this class of article. It would seem scarcely possible nowadays for anyone not to be able to grow flowers, so clear are the directions and particulars given in numerous manuals. The book before us deals entirely with annual and biennial plants in the form of a glorified nurseryman catalogue. By dedescribing it in this way, however, it is not sought to detract from the merits of the work, though it may be remarked in passing that the numerous illustrations, six of which are in colour, are so far inferior to those in the catalogues of our leading seedsmen that they might have been omitted with advantage.

The few pages of introduction give with admirable conciseness the essentials of garden craft for the particular class of plants of which the book treats. The rest of the book is a descriptive catalogue, arranged in alphabetical order, of the various species and varieties of annual and biennial garden plants. The author is to be congratulated on having given in nearly all cases the country of origin and date or introduction of the various plants mentioned, though in this connection the fact that *Tropaeolum minus* was introduced from Peru in 1596 might have been recorded, as it is one of the earliest known introductions to this country from South America. He is also careful to give the natural order of each plant and synonyms, as well as the derivation of the generic name in every case, so that for these features alone Mr. Speer's book deserves a place on the shelf of every garden-lover's library.

Full details as to the procedure to be adopted in the sowing of seeds and subsequent treatment of the seedlings are given at the end of the account of each genus.

Paints for Steel Structures. By Houston Lowe. Fifth edition, revised. Pp. 115. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 4*s.* 6*d.* net.

THIS is a new edition of Mr. Lowe's book, and gives a popular description of the present-day knowledge and experience as to the painting of iron and steel structures. The best method of painting such structures has been for some time attracting the attention of chemists and others in the United States, where a large amount of experimental work has been done, and some very curious and interesting results have been arrived at. Mr. Lowe is familiar with these various experimental tests, and has brought the results together in a convenient and popular form in his little book. There are, of course, a great many interesting chemical problems lying behind the question of the painting and rusting of iron and steel structures, which cannot yet be considered as having been solved, and therefore much that can be said in a book of this kind is tentative. On the other hand, the experience gained by experimental tests, although sometimes difficult to explain scientifically, is of value to the practical man, and guides him as to what it is best to do.

The book, therefore, can be recommended to architects and engineers who have to deal with the painting of iron and steel structures, as they will get a great deal of information in a simple form which will assist them in drawing up specifications for such purposes. A. P. L.

Chemistry of Food and Nutrition. By Prof. H. C. Sherman. Pp. viii+355. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* 6*d.* net.

THIS is a useful book; it contains numerous data on the properties, composition, and calorific value of the principal articles of food, and an up-to-date description of the scientific principles on which a dietary is constructed, and how it can be adapted to the varying needs of the organism. The author has a clear way of putting his points, and has exercised much judiciousness in not overwhelming his readers with too many arguments on disputed points; he has carefully selected his authorities, and the quotations he cites are apt and sufficient. On the controversial subject of the amount of protein necessary for an adult in the day he carefully splits the difference between Voit and Chittenden, and places the amount at 75 grams. The book is well worth careful perusal. W. D. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Racial Problem in Nubia.

IT has been objected that the sketch of the history of Nubia given in the article on "The Unveiling of Nubia" in NATURE, April 27, p. 283, does not agree in every particular with the accounts given by Mr. Firth in the sixth Bulletin of the Archæological Survey of Nubia, p. 8, and by me at the Sheffield meeting of the British Association and in several lectures during the past year.

It must be remembered, however, that the notice in NATURE was a review of the published account of the results obtained by Dr. Reisner during the first season's work of the Archæological Survey, and it did not come within the scope of the reviewer's task to describe the attempts that have been made during the last three years to throw further light upon the significance of the facts set forth in Dr. Reisner's report.

It may prevent such misunderstanding, however, if a brief statement is made of the bearing of recent investigations upon the meaning of the facts brought to light in Nubia. It is not without significance that the archæologists, studying in Nubia the handiwork of the ancient people, and the anthropologists, as the result of the examination in England of the remains of the Nubians that have been sent over here, have arrived quite independently and without collusion at the same interpretation of the significance of the story the pottery and the bones respectively have to tell.

Mr. Cecil Firth's statement of the views of the archæologists will be found in the sixth Bulletin (*op. cit.*).

The working hypothesis that I set up last summer, when all the facts derived from the study of the human remains were being collated for the first time, is not only borne out by the archæological evidence, but has been found to be in full accordance with all the facts which further detailed study of these ancient Nubian remains has brought to light.

It is now quite clear that in pre-dynastic times there were scattered throughout the Nile Valley, not only in the territory we call Egypt, but also much farther south, many groups of people linked to the pre-dynastic Egyptians by the closest bonds of affinity, and also sharing with them a common cultural inheritance. Until the beginning of the period of the Pyramid-builders no difference can be detected either in the physical characters of the people or their achievements on the northern (Upper Egypt) or the southern (Lower Nubia) side of the First Cataract. But as the marshy territory of Egypt was drained, and the extent of its rich habitable land was thus increased ten-fold, there was a movement of population from the barren country above the First Cataract into the more fertile north.

But when the proto-dynastic Nubians emigrated into Egypt their place in Nubia was taken by the next member of the group of peoples that were scattered serially throughout the Nile Valley like beads on a string. As the result of the first season's work in Nubia, the only obvious explanation of the state of affairs revealed in these Nubian graves of the time of the Ancient Empire—the B-group of the archæologists—was found in the hypothesis that the original population of Nubia became tainted with negro blood and fell away from the high standard of culture and technical skill attained by their forefathers. The facts then available did not justify any other explanation. But in the light of the fuller knowledge now in our possession, it is evident that the B-group people were not the direct descendants of the A-group or pre-dynastic Egyptian population of Nubia, but the next bead on the string; in other words, they were members of the southern community of kindred people, next in order in the Nile Valley south of Nubia; and there is no reason to suppose that they had lost any cunning possessed by their ancestors, but rather that they had not kept pace with their northern brethren in the advance of the latter in the paths of civilisation. The evidence for this view is abundant and manifold in kind. I need mention only one fact here—the almost complete absence, among the human remains of the B-group people, of pure negroes, while the whole population is very definitely more negroid than the Egyptians, can only be explained on the hypothesis that the process of admixture took place farther south.

After the time of the Ancient Empire, the next bead on the string—the C-group of the archæologists—was moved north into Nubia. These Middle Nubians, as we call them, were also obviously akin to the pre-dynastic Egyptians, and their burial customs and pottery were clearly derived from the same source as those of the Egyptians: but it is equally certain that the two populations, the Egyptians and the Middle Nubians, had developed along divergent lines. Moreover, the undoubted specialisation of the physical characters of the people, no less than of their arts and customs, was emphasised by the introduction of an exotic African element into the C-group people. They became more definitely negroid than either the A- or the B-group peoples, and their pottery exhibits, no less clearly than their bones, the influence of the negro.

Mr. Firth summarises the archæological statement in these words:—"The theory tentatively advanced in the second annual report that the C-group people represent a later wave (greatly modified by Negro influences) of the same race which founded the Pre-dynastic culture of Upper Egypt, is based on certain affinities in burial-custom and pottery-making, and requires the confirmation which a careful examination of the physical character of the human remains can alone give." The human remains have supplied this confirmation, and they did so before we were aware of the fact that Mr. Firth was asking for the support of the evidence they afford.

His further statement that "the connection between the B- and C-groups does not seem to be very close and a comparison of the two would suggest an independent origin of the C-group" may seem to suggest that there was a much wider hiatus separating the Middle Nubians (C-group) from the earlier inhabitants of Nubia than there was to divide the two groups (A and B) of the latter the one from the other. There can be no doubt there was a much greater contrast between the C-group culture than separated those of its forerunners in Nubia: but it is equally certain that the B-group people, interposed both in time and locality between the A-group (distinctively Egyptian) and the C-group (distinctively Nubian), were much more strongly influenced culturally by the higher civilisation of the former than by that of the latter. Thus the Archaic Nubian (B-group) culture has the appearance of being the direct offspring of the Archaic Egyptian (A-group), but the people themselves form a unit as distinct from its forerunner (A-group) as it is from its successor (C-group).

There is a considerable mass of evidence to suggest that, just as the B- and C-groups represent successive waves, respectively, *circa* 3000 B.C. and 2000 B.C., which moved northward in the Nile Valley, the early pre-dynastic people in Egypt were largely reinforced, perhaps about 4000 B.C., by a precisely similar wave or rather concentration of the scattered primitive Nilotic people in the most desirable part of the Nile Valley.

In these notes I have attempted to suggest the present trend of our investigations without doing more than merely hinting at one out of a multitude of varied kinds of evidence indicative of the northerly trend of the Hamites in the Nile Valley, leading to a concentration in Egypt.

G. ELLIOT SMITH.

Manchester, April 29.

Inheritance of Row-numbers in Maize Ears.

IT is well known among maize-growers that the number of rows of grain on an ear of maize varies from 8 to 24, or even more, according to the breed; also that in the same breed the number may vary within certain limits, *e.g.* 8, 10, or 12 in some breeds, 12, 14, 16, or 18 in others and 18, 20, 22, or 24 in yet others. In some breeds the range of variation is even greater than I have indicated, while in others it seems to be more closely limited. In some breeds an ear carrying more than 8 rows is considered untrue to type, but I am not aware that any

South African grower has yet succeeded in fixing the number of rows in any breed to such a degree that *no variation* occurs in that respect.

In the course of a series of breeding experiments I am conducting, which are not yet completed, I have met with the following interesting case.

Thirty-three plants of "Arcadia" sugar-maize, each of which bore two well-developed ears, were studied as regards number of rows. On 21 plants the number on the upper ear was different from that on the lower, while on 12 plants the number was the same on each ear. Of the 21 plants on which the number of rows differed on the two ears, 13 had a larger number on the lower than on the upper, while 8 had a smaller number on the lower than on the upper. The distribution of rows was as follows:—

Class	Upper ear	Lower ear	Number of plants	Number of plants in each class
As many rows in lower as in upper	12	12	8	—
	10	10	3	—
	8	8	1	12
More rows in lower than in upper	10	14	1	—
	10	12	6	—
	8	12	3	—
	8	10	3	13
Fewer ears in lower than in upper	12	14	1	—
	12	18	4	—
	10	8	3	8
				33

Summary.

8	8	1	—
	10	3	—
	12	3	7
10	8	3	—
	10	3	—
	12	0	—
	14	1	13
12	8	0	—
	10	4	—
	12	8	—
	14	1	13
			33

The total number of ears producing any given number of rows was as follows:—

Rows	8	10	12	14	
Ears	11	23	30	2	Total 66

The "Arcadia" is a white sugar-maize obtained from a cross between a normally 8-rowed "Black Mexican" and a white flour-corn normally bearing a larger number of rows, but I do not know that either was pure bred, for row numbers and no subsequent selection in this line had been made.

It is generally supposed by maize-growers, in this country at any rate, that the number of rows is a definite, heritable character. Results obtained by crossing two other breeds, an 8-row and an 18-row (each believed to be pure as regards this character), have this year produced irregular results in the F_1 generation, for which I have not yet been able to account. However, the case described above seems to indicate that the development of rows is, within certain limits, a vegetative character depending in part on seasonal conditions and on food supply. This view is strengthened by the fact that this is the first year in which I have noticed 14-row ears in this breed, all the parent ears for two or three generations having been 8-, 10-, or 12-rowed (so far as I am aware). At the same time, there is ample indication that, within certain limits, row-numbers are inherited in the maize plant, but it is doubtful whether any South African strains are yet sufficiently pure-bred for this character to demonstrate the point with absolute certainty.

JOSEPH BURTT-DAVY.
(*Government Botanist.*)

Department of Agriculture, Pretoria, April 17.

Absorption Markings in "K" Spectroheliograms.

IN a letter published in NATURE of March 30, Mr. Buss suggests that the evidence derived from some spectroheliograms taken by M. Deslandres at Meudon conflicts with that which I obtained from the Kodaikánal daily series.

There is no such "divergence of evidence" in reality. The dark marking shown on our plates of March 21, 1910, and described as vague and ill-defined, is doubtless much more clearly seen in the plates obtained with the Meudon high-dispersion spectroheliograph, which isolates the central absorption line K_3.

With the dispersion available in the Kodaikánal instrument, the K_3 line is about half the width of the camera slit, and photographs taken with the slit exactly central on K integrate the light of the absorption line and of the side components of the emission line K_2. As the dark flocculi or absorption markings seem to be entirely due to variations in intensity in the narrow absorption line, it is rather a matter for surprise that in our photographs they should be so clearly defined in many cases. In the original negatives taken on March 21, 1910, in addition to the broad, ill-defined shading already mentioned, there are clearly seen all the curious linear markings so beautifully shown in M. Deslandres' K_3 plate of this date, and I can find no appreciable differences in the contours of the markings.

With regard to the disappearance of the enormously extended marking between March 25 and 26, had Mr. Buss read the paragraph in my article referring to this with ordinary attention, he would not have suggested that the absence of the marking on the plate of March 26 was due to imperfect adjustment of the spectroheliograph slits. Very possibly the disappearance shown by our plates was not absolute, and K_3 or Hα plates taken on the same day would have shown the marking, but if so the reduction in intensity compared with the previous day would have been marked.

The theory apparently advocated by Mr. Buss, that the absorption producing these markings takes place above the prominences, receives no support from our visual or photographic observations, and his remarkable observation of a dark flat cloud hovering over the bright prominence at each successive appearance east or west seems to be unique! No trace of so extraordinary a feature can be seen on any of our numerous photographs of this prominence.

J. EVERSHED.

Kodaikánal Observatory, April 18.

Calendar Reform.

MAY I trouble you with one or two observations on the excellent article which appeared in NATURE of April 27.

Referring to the application of the principle of the *dies non*, or the setting aside of a day annually not included in the weekly enumeration, the author of the article says "the week can boast a most ancient lineage uninterrupted by the slightest break." Is this certain? I find Dr. Hale in his "Chronology," vol. i., p. 67, says:—"If the year of the Crucifixion was A.D. 31, as is most likely, it follows from an eclipse of the moon in Pingre's tables, April 25, at 9 afternoon, that the Paschal full moon that year fell on March 27, which in the calculations of Newton, Ferguson and Lamy, and the computation of Bacon is reckoned *Tuesday*," &c. I might adduce other reasons for doubting if the continuity of weeks has been uninterrupted. It must be remembered that for some time, at any rate, throughout the Roman Empire the odd day in leap year was treated as a literal—not merely as a legal—*dies non*, being regarded as part and parcel of the day preceding.

Nevertheless, I agree with the author that prejudice in this matter cannot be disregarded.

But no such objections can be stated to the proposal to apply this principle to the *months*, *i.e.* to treat the 365th and 366th days as without the monthly enumeration, and to equalise so far as possible the lengths of the months so as to give four quarters of 91 days, or 13 exact weeks.

It is hopeless to suggest that the present arrangement of months has any scientific or religious sanction or advantage.

I hope shortly to present to the public more fully the arguments in favour of this really non-contentious part of

the proposal, to which in the first instance I think the reform should be confined.

Astronomers are apt to ask, *Cui bono?* But though the advantages of such a simplification would to them be small, they would be enormous, innumerable, and universal to the lawyer, the statesman, the banker, broker, &c.—indeed, to public business, commerce, and education in all civilised countries.

If without infringing any scientific principle or violating any religious symbolism benefits so general can be conferred so easily, I feel sure that scientific men will not stand in the way. Indeed, many of them are in the forefront of the movement.

What we want is a simply natural and naturally simple scheme. I am afraid that suggested by your correspondent —very ingenious as it is—is for that reason unsuited for general use. ALEX. PHILIP.

The Mary Acre, Brechin, N.B.

FROM Mr. Philip's letter it appears that he, at all events, is conscious of the grave difficulties in the way of interrupting the continuous succession of the days of the week. It would be idle, therefore, to argue this point further, or to insist in greater detail on the importance of what Laplace called "peut-être le monument le plus ancien et le plus incontestable des connaissances humaines" (la semaine).

The date of the Crucifixion depends on questions relating to the Jewish, not the Christian, calendar. Now it seems incredible that the Hebrew communities have failed to maintain the order of the Sabbath without a break. If this be granted, the only deduction to be drawn from Mr. Philip's argument is that the Crucifixion did *not* occur in the year 31; which, indeed, according to the most recent chronological view, is most highly probable.

Mr. Philip's argument in favour of equalising the months will be received with interest when it appears. When, however, it is realised that the suggested change will not give us a fixed calendar, it may be doubted whether this minor adjustment, free from objection as it may be, will be found to have the necessary driving force behind it to secure its adoption. H. C. P.

A Zenith Rainbow.

AN interesting rainbow was visible from the Bruges-Ostend canal here at 4.30 p.m. on April 17, in fair weather, almost due west.

The sight at once evoked the expression that the bow was inverted. It was clearly visible for several minutes, and subtended an arc of about 20°.

On shielding the eye from the direct light of the sun, this arc was seen to extend much farther, and formed part of a circle with the zenith as apparent centre, the radius of the circle being estimated from 10° to 15°.

The inside of the bow was violet, the colour following the usual order to red; the intermediate colours were, however, not characterised by the sharpness often seen in the ordinary rainbow.

The state of the sky at the time was misty near the horizon, but otherwise brilliant with high fleecy clouds, with a light wind from N.N.W.

The bow was backed by a thin broken cloud, which presented a "curtain" formation as far as the angle of the sun.

No rain was observed to fall at the time or during the day. No primary or secondary bow was visible, which, among other things, excludes the idea of the bow observed being a tertiary one.

It would be interesting to know whether this type of bow is of frequent occurrence. K. C. KREYER.

7 rue des Lions, Bruges, Belgium, April 18.

IT appears from Mr. Kreyer's description that the phenomenon observed was the upper arc of contact of the halo of 46° radius. The altitude of the sun was about 24° at the time, so that the height of the point of contact would be about 70°, and the centre of the arc, accepting your correspondent's estimate of 10° or 15° radius, would be at an altitude of 80° to 85°. The phenomenon is described by Pernter as the most beautiful of all halo phenomena, and it occurs often when no trace of the 46° halo is visible; the colours, with the exception of the violet, are definite and brilliant, with the red towards the sun. The violet seen by your correspondent is more rarely present. The cloud with "curtain" formation was probably cirro-stratus, and would be formed by the ice crystals which give rise to halo-phenomena.

The bow observed is not of frequent occurrence (about seventy had been observed up to 1883), and it is interesting to have a record of it. E. GOLD.

Meteorological Office, South Kensington, London, S.W., April 27.

Daylight Saving!

THE following aspect of the Daylight Saving Bill does not appear yet to have been noticed.

A man who is accustomed to rise at 9 a.m., lunch at 1.30, dine at 7.30, and go to bed at 11.30 will naturally object to turning out of bed an hour earlier on a dull, grey, cold April morning. So, when the clocks are put forward, he will consider that the change is only nominal, and will continue to follow the old hours, rising at 10, lunching at 2.30, dining at 8.30, and going to bed at 12.30. When, however, the clocks are put back the weather is getting bad, and the pleasantest part of the day is after the blinds have been drawn and the gas lit; he will be glad of the extra hour's sleep in the dark morning, and the increased fireside comfort in the evening, and will be so accustomed to regard 10 o'clock as the time for getting up, 2.30 as lunch time, 8.30 as dinner time, and 12.30 as the time for going to bed, that he will certainly not want to go back to the old clock reckoning. Thus "daylight saving" will mean a saving of an hour's daylight in the dark winter months and a gain of an hour's gaslight.

"THE VOICE OF THE SLUGGARD."

DAYLIGHT AND DARKNESS.

WHATEVER may be thought of Mr. Willett's so-called daylight-saving scheme, it is impossible not to admire the persistence with which he pursues the idea, and secures support for it from city corporations, town councils, chambers of commerce, members of Parliament, and other people who are attracted by the advantages offered, and do not realise how unscientific the scheme is, or the gravity of the objections to the adoption of a variable standard of time-reckoning. We do not believe for an instant that the Government is likely to give facilities for legislation on the lines of the Summer Season Time Bill, however sanguine the promoters of the Bill may be As, however, a meeting at which the Lord Mayor presided, and the Home Secretary spoke, was held at the Guildhall on May 3, it is worth while to consider again some aspects of the proposals usually overlooked.

The promoters of the Bill have circulated a mass of literature, in which the advantages are emphasised and the objections disregarded. Among these communications is an article contributed to *Die Woche* by Dr. E. von Engel of Berlin, who supports warmly the proposition of accommodating the standard meridian of Greenwich to that of Berlin or Mid-Europe. We have no doubt he is perfectly sincere in his recommendation. At the same time, the advantages of making the hours of business in England coincide with those in Germany is entirely in favour of the latter country.

In consequence of this renewed earnestness and vigour of the daylight-saving movement, it is desirable to express, concisely and decisively, some fundamental objections to a scheme which can be made to present so much that is agreeable. This is the more necessary because there is a feeling that scientific men are inclined to display a selfish regard for their own convenience, and a contemptuous indifference to

national requirements and economy. It is needless to say that such a view completely misrepresents the character of the scientific objection to the scheme. Let us admit, as fully as the most ardent of the supporters of Mr. Willett's scheme could wish, that the acceptance of his proposed legislation will do all that he demands for it: that it will give London 154 more daylight-using hours in the year, that it will reduce the lighting expenses in all industrial operations, that it will improve the health of the nation and be productive of other advantages. It is still incumbent upon the promoters to show that the machinery which they propose is the best adapted to the end in view, and that it will be effective. Our contention is that they have sought to effect the amendment they desire in an objectionable manner. Our lives, duties, business, and pleasures are not uniformly distributed throughout the hours of daylight. Then let us have a more systematic arrangement. What should be aimed at is a modification of our habits on judicious lines. It should be the business and the effort of Mr. Willett and his friends to cultivate a more enlightened public opinion, to persuade people to adopt more rational customs. He has tried to get a desirable result by a wrong method; we might say, by a disingenuous method.

Of course, it may be argued, as Dr. von Engel does, that "No society, however powerful, would be able to induce a universal movement for early rising for increasing our enjoyment of the sunlight." If not, why not? What has been the determining factor by which the conduct of life has been continually shifted later in the day? It is not impossible that the preference for the afternoon has been brought about by the necessity or convenience of regulating life not by light, but by heat. The heat meridian does not coincide with the light meridian, but is some two hours or more after it, and the day is arranged apparently so as to make available the greatest amount of heat. Mr. Willett asks us to disregard this effect. He does not seem to see, or at least does not admit, what is perfectly obvious to all who have given the matter sufficient consideration, that if more light is utilised in the morning, there is also a lower temperature to be encountered. To have to burn a fire in the early morning would be a very decided set-off to the use of less artificial light at night. But on this view we do not insist. We are content to make the point, that heat as well as light should be considered, and that its importance in the comfort of life cannot be neglected, as is shown by the social arrangements that obtain in other countries of Europe, as well as in the Tropics. But perhaps the promoters of the scheme for periodically changing the standard meridian contemplate also a seasonal variation of the thermometer scale. It would be just as reasonable for Parliament to enact that, in certain months, a temperature of, say, 60° should be called 70°, as it would be to agree that for a certain part of the year 6.0 o'clock should become 7.0 o'clock.

In his speech at the Guildhall, Mr. Churchill referred to some points upon which we have a few words to say. He mentioned that the agricultural population of the country already make full use of daylight hours in the various seasons, and that thousands of firms and offices (he might have included the Board of Education) have different working hours in summer and winter. A not inconsiderable number of people thus solve the problem in the most reasonable way by adapting their habits so that the best use is made of daylight. This would seem to provide an argument for urging similar action upon other sections of the community, but scarcely furnishes a reason for compulsory alteration of the clock upon days prescribed by Act of Parliament. It is only in a great city like London that individuals whose hours of work and leisure vary with the seasons can be said to suffer any difficulty or inconvenience because, as Mr. Churchill said, they are "out of contact with the customary time-table of the nation." There is no general time-table of life and labour followed in the United Kingdom as a whole. The "customary time-table" of London differs as regards evening meals and amusements from that of nearly all other cities in the kingdom, being an hour or more later than is usual in most provincial towns. If custom is to be considered in the scheme for the division of daylight and darkness, then London will require the clocks to be advanced by two hours to be placed in the same position as most places in the provinces where the clocks would be put forward for one hour.

It is also forgotten by the promoters of the scheme that the daylight hours of London and other places in the same latitude differ considerably from those of places farther north. At Aberdeen, Dundee, and Edinburgh, for instance, lighting-up time for vehicles in the present month is about 35 minutes later than in London, and next month it will be three-quarters of an hour later, that is, about 10.0 p.m. Scotland has, in fact, a natural extension of the daylight hours in the summer months without any need for legislation. At Edinburgh and all places north of it there are not sufficient hours of darkness in May, June, and July for the normal eight hours of sleep required by men or women, and there would be no advantage in advancing the clocks by an hour from the third Sunday in April to the third Sunday in September. The 154 hours "more daylight" which Mr. Churchill says would be secured by the scheme "to the whole people of these islands," are already possessed by the people of Scotland between April and September. Why not suggest, therefore, that for certain months of the year the latitude of Edinburgh shall be the latitude of all other places south of it in the United Kingdom, instead of proposing that the longitude of Berlin shall be the longitude of Greenwich?

Another point referred to by Mr. Churchill was the ease with which the change of nine minutes from Paris to Greenwich time was effected recently in France. It is difficult to understand how this action can be held to afford any support to the scheme of "daylight saving." Our own view is that, as France has now adopted the Greenwich meridian as its standard for time-reckoning, it would be an unfriendly and injudicious act for us to abandon Greenwich time for German time during an arbitrary period of the year. France has now come into line with the international system of time-reckoning based on standard meridians beginning with the meridian of Greenwich and extending round the whole civilised world. These meridians are permanent standards at present, but if the principle of the daylight-saving scheme were accepted they would oscillate east and west on different dates, and hopeless confusion would be introduced in the place of a scientific system.

The fact that it is easy to advance one's watch by an hour when entering the zone where Mid-European time is kept, and to put it back an hour when leaving the zone, provides no argument for the alteration of the time of the United Kingdom twice a year. When you move fifteen degrees east you really do reach a longitude at which the time, as indicated by the sun's position, is an hour in advance of Greenwich time. Noon occurs nearly an hour earlier at Berlin than at Greenwich, whatever

standards of time are adopted, so it is natural to adapt one's watch to the new conditions when reaching Germany. By the daylight-saving scheme, 11.0 Greenwich time would be called 12.0 noon during the summer season; that is to say, the sun would be considered to have reached its highest point for the day an hour before it actually does so. Of course, we remember that there is a difference between apparent time and mean time, but the variation of the equation of time does not effect the affairs of everyday life. When, however, it is proposed that Parliament should grant powers to enable the people of the United Kingdom to pretend that during summer months noon at Greenwich corresponds to noon in the neighbourhood of Berlin, it is time the absurdity of the scheme was exposed. The scheme is unworthy of the dignity of a great nation, and if it were made compulsory by legislation, it would be a monument to national flaccidity. We cannot think that the Government will lend its support to proposals which involve more international consequences than the promoters are aware of, and would make us the laughing-stock of the enlightened people of the world.

THE NEW ENCYCLOPAEDIA OF SPORT.[1]

FROM a biological point of view two articles in this issue are especially noteworthy, namely, one on the Arabian horse, by the well-known breeder, Mr. W. Scawen Blunt, and one on grouse disease, by Dr. Shipley. The former stands as it was in the first edition, the author stating that he has practically nothing to add or alter. Its special interest lies in the fact that the author still maintains the theory that the Arab horse, in place of being a comparatively late importation, originally existed in a wild condition in the comparatively desert districts of Nejd and the central plateaus of Yemen. On the other hand, such historical evidence as exists does not indicate that the natives of Arabia were in possession of tame horses at a very early period, and this seems to weigh considerably against the idea of the former existence in the country of a wild race.

The article on grouse disease, to which Dr. H. B. Fantham contributes the section on the coccidiosis of young birds, has been written specially for the present edition, and is therefore thoroughly up to date, although the author is careful to add that many of the inferences and conclusions referred to must be regarded as more or less provisional. This contribution, which is well and profusely illustrated, is thoroughly worthy of its author, but since Dr. Shipley's investigations into grouse disease have been already reported in NATURE, further mention is unnecessary.

The other articles on natural history subjects display that pleasing variety of treatment to which allusion was made in my review of the first volume. For instance, whereas Mr. Bryden, in the article "Deer" (which appears to have been compiled from the "Deer of All Lands"), treats his subject almost exclusively from a zoological point of view, the writers of "Elephant" confine themselves mainly or entirely to the sporting aspect of their theme, making no reference to the local races of the African species. On the other hand, in the article "Giraffe," Mr. Bryden does record most of the local forms of that species. Need of revision in the article last mentioned is evident from the repetition of the old statement (which was not true previous to the discovery of the okapi) that "the giraffe forms a distinct family of its own." Neither is Mr. Selous quite faultless when writing of the African elephant, since he repeats the old error of this species being "somewhat less in bulk and stature than either the mastodon or the mammoth." Nomenclature is also, as in the first volume, distinctly erratic, Mr. Bryden, in the article "Deer," denominating the Chilian guemal *Mazama bisulca*, whereas Mr. Hesketh Prichard, in the article "Guemal," calls it *Xenelaphus bisulcus*.

Tora Hartebeest and Grant's Gazelles. From "The Encyclopædia of Sport."

That the editor has endeavoured to bring the biological articles up to date is, however, quite evident, as, in addition to the already mentioned article on grouse disease, there is one, by Mr. Bryden, on the African forest-hog (Hylochœrus), a genus originally described in NATURE. In this effect he

[1] The Encyclopædia of Sport and Games. Edited by the Earl of Suffolk and Berkshire. A new and enlarged edition. Vol. ii. Crocodile Shooting—Hound Breeding. Pp. viii+448. (London: W. Heinemann, 1191.) Price 10s. 6d. net (abroad 12s. 6d. net).

may be said, on the whole, to have been fairly successful, for, in spite of slips and inconsistencies like those just referred to, the average sportsman will find practically all the information to be expected from a work of this nature in regard to most of the animals of which he may be in search, and as the work is essentially one for the sportsman, this is really all that can be legitimately demanded.

From first to last the volume is thoroughly well illustrated, both as regards plates in colour and text figures, some of the latter, as exemplified by the one herewith reproduced, being really exquisite.

As regards subjects other than natural history, the articles, so far as I am capable of judging, are all that they should be, and as most of them are written by experts, they bear the imprimatur of authority. Of those in which I am personally much interested mention may be made of Mr. Rawdon Lee's "Dogs," which contains precisely the sort of information suitable to those who are not specialists in canine matters. If the all-round lover of sport, in the widest sense of the word, is not thoroughly well satisfied with the volume as a whole he must be very hard indeed to please. R. L.

WHEATS AND FLOURS.[1]

REPRESENTATIONS having been made to the Local Government Board by various medical officers of health and public analysts on the growth of the practice of bleaching flour, and stress having been laid on the prohibition of bleaching in the United States of America, Dr. Hamill received instructions from the Board to make inquiries as to how far the practice obtains and to what extent, if at all, it is justifiable. In this report, after indicating the sources of supply, he describes the milling of wheat and grading of flour; then, after indicating what are the factors determining the quality of flour, he proceeds to discuss bleaching processes and their effect.

In roller milling the production of flour is a gradual operation. The wheat passes through a series of fluted, chilled, iron rollers, the product from each pair being sifted before passing to the next; at each stage the fragments of endosperm, as they pass through, are further reduced, and the flour separated out. It is possible for the miller either to collect in one portion the whole of the flour produced, the mixture obtained being termed a "straight run flour"; or he may separate it into two or more portions, the one being derived from the first two or three pairs, the other from the last pair, of rollers. Flour is arbitrarily graded into "whites" or "patents," representing the product from the first few rollers, and "households," representing the rest of the flour; a further subdivision is made when required. There is a difference in price of as much as 5*s*. or 6*s*. per sack of 280 lb. between the highest and lowest grades.

Millers in this country have to deal with wheats coming from all parts of the world, and some of them acquire great skill in so blending and milling the wheats at their disposal as to produce a flour of absolutely uniform behaviour in the bakehouse throughout the year; this is a matter of the very greatest importance to the baker, who has learnt to appraise the market value of flour from its baking qualities and appearance. For many years past the baker has had to satisfy the demand for a very white loaf, especially on the part of the operative classes.

Dr. Hamill might with advantage have considered this point in greater detail; the demand arises apparently in part from prejudice, dating from a period when cheap bread was very much adulterated and dark in colour; it is in part based on the fact that the whitest bread, as a rule, is the lightest in texture and the most digestible. Colour in bread is probably more a question of optics than due to the original colour of the flour—a yellow, strong flour will often make a whiter loaf than a weak, very white flour. The baker attaches importance not merely to colour, but to freedom from specks of offal or dirt. Stone milling has been almost superseded by the more complicated process of roller milling, because the latter permits of the more or less complete removal of bran and other undesired parts of the grain. As Dr. Hamill points out:—

"In stone milling a large, if not the greater, part of the germ is lost in the offal; only a portion finds its way into the finished flour.

"In both stone and roller milling it is possible to obtain a yield of flour representing anything between about 70 and 100 per cent. of the wheat milled, according to the amount of offal included in the flour. As a rule, the greater the amount of offal in the flour—*i.e.* the greater the percentage yield of flour obtained from the wheat—the darker is the loaf which it will produce. The colour of the loaf, however, depends not only upon the amount of offal which the flour contains, but upon the milling process adopted (stone or roller milling) and upon the colour of the wheat used (red or white). For these reasons different flours containing the same percentage (above 70 per cent.) of the total wheat may yield loaves varying very considerably in colour."

The question of the relative food value of different wheats or of the flour from different parts of the berry in no way enters into the consideration of its market value.

The bleaching of flour is effected commercially with nitrogen peroxide; it appears to be impossible to detect a bleached flour by mere inspection. Flour which has been badly dressed, containing particles of offal, is unsuitable for bleaching, as this only makes the specks more conspicuous.

Dr. Hamill concludes that bleaching produces no effect upon the baking qualities of flour. It improves the colour of the whole output of the mill and represents a pecuniary gain, since it gives the miller a larger percentage of high-grade flour. It is of assistance in maintaining uniformity in the appearance of flour, but at the same time it enables the miller to use cheaper wheats (*not necessarily of lower food value*). There is no evidence that bleaching enables good flour to be made from unsound wheat.

Flours are classed as strong or weak, according as they will produce large well-risen loaves or not. This property is in some way connected with the character of the protein of the flour, and it has been the subject of a great deal of experimental work within recent years. It is a well-known fact that the properties of colloidal substances, to which class the gluten of flour belongs, are profoundly modified by small quantities of electrolytes, and it has been found that the treatment of weak wheat during milling with small quantities of phosphates causes the flour obtained to be "stronger" than it would otherwise be. As a consequence, it is possible to make from weak British wheat a strong flour, the bread from which has the rich flavour characteristic of our flours. Seeing that bread of the type demanded throughout the country cannot be made without a considerable proportion of a strong flour, it would seem justifiable to conclude that the new invention will enable a larger proportion of British flour to be used in our bread, much to the advantage of the community—incidentally it should increase the value of British flour which

[1] Reports to the Local Government Board.
(1) On the Bleaching of Flour and the addition of the so-called 'Improvers" to Flour: by Dr. J. M. Hamill.
(2) On the Chemical Changes produced in Flour by Bleaching: by Dr. G. W. Monier-Williams.
(3.) On the presence of Calcium Sulphate in Baking Powder and Self-Raising Flour: by Dr. J. M. Hamill.

to-day, on account of its "weakness," only commands bottom prices. Legislation in the direction suggested would thus put British wheat at a disadvantage.

Dr. Hamill does not accept this view, basing his objection partly on the ground that it is not desirable to make any additions to flour, partly on the fact that an originally low-grade weak flour is substituted for a high-grade one; finally, on the fact that since strong American flours contain more protein than weak British flours the food value of the bread is diminished. Here it is necessary to join issue with him. Bread is eaten as a source of carbohydrate and as a diluent to the concentrated fat and protein foods and not as a source of protein. Whether it contains half a per cent. more or less of protein is quite immaterial to the consumer.

It was clear to those who took part in the visit to Canada of the British Association that strong wheats will sooner or later have to give way to weak wheats wherever the two come into direct competition, on account of the much higher crop yields given by the latter. As a consequence, the character of our bread will change unless science in the meantime enables us to produce strong flour from a weak wheat. To cramp progress in this direction at the very outset would appear to be absurd.

It is at times stated on very inferior evidence that bleached flour is injurious to health; Dr. Harden's authoritative statement to the contrary which is recorded in an appendix to the report should settle this question finally.

The report of Dr. Monier-Williams on the chemical changes produced in flour by bleaching is full of valuable and suggestive matter. At the same time very many of his results are open to technical criticism, especially those of the experiments dealing with enzymes. It is obvious that much work remains to be done.

It is clear that the issues considered in the report are of great public importance, but the questions raised are so difficult and of such complexity that it is impossible to arrive at any final opinion on the evidence at present available. It is obviously necessary that the whole subject should be submitted to discussion from the chemical, the physiological, and the practical side, including the agriculturist, as well as the miller and baker. Dr. Hamill shows a very strong bias in the direction of forbidding any treatment whatsoever of flour, although he is unable to produce convincing evidence in support of his conclusions; seeing that his experience is very limited, it is to be hoped that the subject will be remitted to competent observers for full discussion before any steps are taken to introduce restrictive legislation.

Since the above was written, the members of the National Association of British and Irish Millers at a general meeting have adopted a resolution to the effect that wheaten flour sold as such without any qualifying designation should be the unbleached and untreated produce of properly cleaned and 'conditioned' wheat only." They ask the Government to appoint a Board of Reference, consisting of properly qualified experts, to consider thoroughly the whole question of bleaching and the addition of foreign substances to flour.

ORIENTAL SILVERWORK.[1]

MR. LING ROTH, who, in dealing with obscure chapters of anthropology and art, such as Tasmanians or Dayaks, or the brasswork of Benin, has already proved himself a good compiler, has now, in describing Malay and Chinese silver work, found a subject well suited to his powers. Few people, he remarks, have ever heard of Malav silverwork; South Kensington has only half a dozen specimens. The objects illustrated in this volume come from private collections made by officers who have served among the Malays, Messrs. Cecil and Leonard Wray, W. A. Luning, and Dr. C. Hose.

This scarcity of material is due to at least two causes. In the first place, so far as the Malay Peninsula is concerned, this phase of art is practically dead. The old rajahs and sultans, like the nawabs

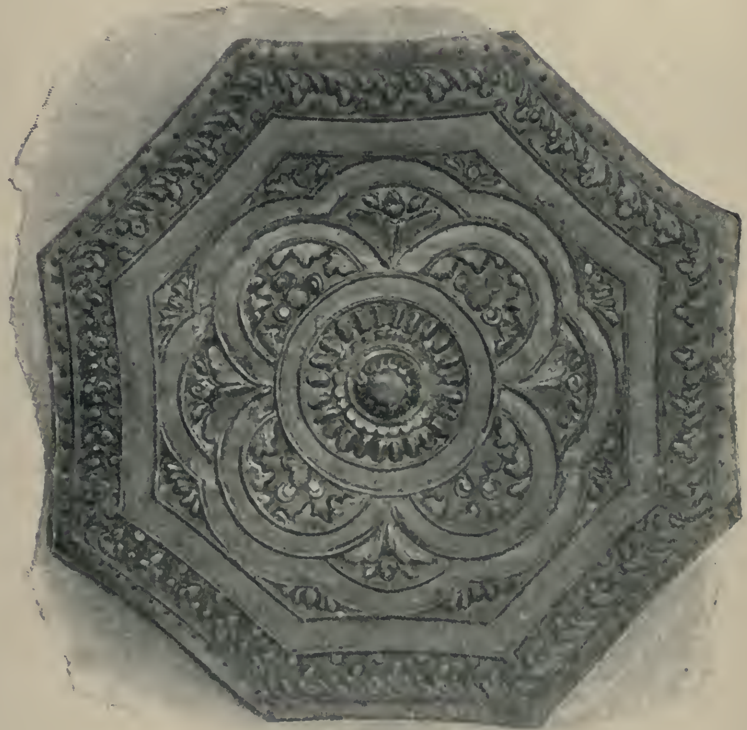


Fig. 1. Buntal (Octagonal Pillow-end Plate), diameter 4½ inches. Lotus pattern at centre. From "Oriental Silverwork, Malay and Chinese."

of Oudh and other Indian princes, amidst their ill-organised households and troops of retainers, used to keep in their service gold- and silversmiths, who worked only for their masters, and produced nothing for the market. With new tastes and wants suggested by contact with foreign culture, this condition of things has passed away. It must be said, however, that among the Malays the decay of the local crafts cannot be attributed to the introduction of European trumpery, though this seems to be the case among the branch of this people in Borneo. In the second place, Malays have a traditional respect for their old art products, and will not sell them except under extreme pressure of circumstances. In this connection Mr. Ling Roth might well have quoted the interesting account by Mr. W. W. Skeat of the magical powers ascribed to the regalia in Malay native

[1] Oriental Silverwork, Malay and Chinese. With over 250 original illustrations, a Handbook for Connoisseurs, Collectors, Students and Silversmiths. By H. Ling Roth. Pp. iv+300. (London: Truslove and Hanson, Ltd., 1910.) Price 21s. net.

courts, a feeling which has possibly extended to art work in the precious metals and has had the effect of checking its dispersal.

The problems of the origin and affinities of this school of art work have not been fully dealt with by the author, and the material available is scarcely sufficient to form the basis of a comprehensive examination. The Peninsula is inhabited by a very mixed population, and it has been the meeting-ground of more than one ancient civilisation. Of these the most powerful is clearly China, which now supplies numerous emigrants who form an important ethnical element. To the west lies India, to the east Java and Siam. Probably all these have contributed something to the general stock of form and design. But in addition there is undoubtedly much that is indigenous.

As regards decoration, we find nothing which can be traced to architectural forms, and little which is specially religious. The introduction of Islam, which places a rigid taboo on delineation of the human form, has had far-reaching effects, and the motifs have necessarily been largely drawn from local vegetable life. These, again, have undergone considerable modification, partly resulting from the the natural tendency in all such art to become conventional, and partly under direct Chinese pressure. The lotus design which frequently appears in the patterns, may have come from either China or India, and further study of the ornamentation will probably show that more has come from India than Mr. Ling Roth is at present prepared to admit.

The examples which he illustrates are chiefly small objects—boxes for holding tobacco, betel, lime, salves, or unguents, bowls and saucers, and the curious end-pieces attached to pillows, which, like many of the other objects, are ostentatiously paraded at wedding processions (Fig. 1).

The methods of manufacture, which are fully described by Mr. L. Wray, represent what is known in European art as repoussé, a thin plate of silver being placed on a lump of softened gum-resin and worked from the back by a series of punches. Graving is little used, and the results attained show considerable artistic skill. As is usual in Oriental art, the craftsman uses no fixed design and much is due to his taste and invention.

This book may be safely recommended to students of Oriental metal work, and to art classes, particularly at centres where the study of silver and gold plate is specialised, and designers in other branches of art productions may find useful suggestions in the excellent photographs with which it is illustrated.

NOTES.

In *The Daily Mail* of Monday last, Sir Ernest Shackleton made an urgent appeal to the British nation on behalf of the Australasian Antarctic Expedition, which, it is hoped, will start in June under the command of Dr. Douglas Mawson. In his letter Sir Ernest Shackleton points out that Australasia has done much for south polar expeditions which have started from this country, and he asks for help, "from this side of the line and from Australians and New Zealanders who are gathering in London for the Coronation," towards the sum of 12,000*l.* needed to purchase a suitable ship, which has been selected by Dr. Mawson, and to enable the expedition to start in June. The Royal Geographical Society has already subscribed 500*l.*, as in the case of Captain Scott's expedition, and a committee has been formed in Australia to assist the explorers. As the result of the appeal, and the steps taken by *The Daily Mail* to bring it under the notice of people interested in exploration, the sum of nearly 9000*l.* had been subscribed by Wednesday morning, and there is little doubt that the whole amount required will be provided. Dr. Mawson proposes to take a monoplane with him for use during the expedition.

A COMMITTEE of the Geological Society has been formed to secure the means of providing a memorial to the late Prof. T. Rupert Jones, F.R.S., in aid of his widow and daughters. The late Prof. Jones was never in receipt of more than a very moderate income, and receiving only a small pension upon his retirement thirty years ago from the post of professor of geology in the Royal Military College, Sandhurst, he was unable to make any suitable provision for his family at his death, when his pension ceased. During his long life Prof. Jones was an ardent geologist and palæontologist, and the author of nearly 200 separate papers or other works, some of which were mentioned in our obituary notice published in NATURE for April 27 (p. 287). Subscriptions towards the proposed memorial may be sent to Prof. W. W. Watts, F.R.S., president of the Geological Society, Hillside, Langley Park, Sutton, Surrey, who has consented to act as treasurer to the fund. It is to be hoped that the committee's appeal will meet with a ready and generous response.

THE council of the Pharmaceutical Society has elected the following honorary members in recognition of their distinguished scientific work:—Prof. W. E. Dixon, F.R.S., professor of pharmacology, King's College, London; Dr. Adolph Engler, director, Botanical Museum, Berlin; Prof. Percy F. Frankland, F.R.S., president of the Chemical Society; M. Eugène Léger, late president Société de Pharmacie de Paris; pharmacien en Chef de l'Hôpital St. Louis, Paris; Lieut.-Colonel D. Prain, C.I.E., F.R.S., director of Royal Gardens, Kew; and Dr. Ludwig Radlkofer, professor of botany, University of Munich.

ON Tuesday next, May 16, Prof. F. W. Mott will begin a course of two lectures at the Royal Institution on "The Brain and the Hand"; on May 18 Dr. W. N. Shaw will deliver the first of two lectures on "Air and the Flying Machine": (1) "The Structure of the Atmosphere and the Texture of Air Currents," (2) "Conditions of Safety for Floaters and Fliers"; and on Saturday, May 20, Mr. W. P. Pycraft will commence a course of two lectures on "Phases of Bird Life": (1) "Flight," (2) "Migration." The Friday evening discourse on May 19 will be delivered by Prof. R. W. Wood on "Recent Experiments with Invisible Light," and on May 26 by Prof. Gilbert Murray on "The Greek Chorus as an Art Form."

THE provisional programme of the International Congress in Naval Architecture and Marine Engineering, to be held in connection with the jubilee of the Institution of Naval Architects in July, has been issued. On Monday, July 3, there will be a reception at the Royal United Service Institution. On Tuesday, July 4, the International Congress will be opened by H.R.H. the Duke of Connaught, K.G. The three following days, July 5, 6, and 7, will be devoted to the reading and discussion of papers contributed by Admiral Sir Cyprian Bridge, G.C.B., Sir Andrew Noble, Bart., K.C.B., Sir William H. White, K.C.B., Sir Philip Watts, K.C.B., the Hon. C. A. Parsons, C.B., Mr. S. W. Barnaby, Dr. S. J. P. Thearle, Mr. C. E. Ellis, Colonel G. Russo (*Italy*), Admiral Kondo, (*Japan*), Mr. Uchida (*Japan*), Count Shiba (*Japan*), Prof. Terano (*Japan*), Konsul Dr. O. Schlick (*Germany*),

Geheimrat Prof. Flamm (*Germany*), Prof. A. Rateau (*France*), and Mr. J. Johnson (*Sweden*). On Thursday, July 6, there will be a visit to the National Physical Laboratory to inspect the national experimental tank, and in the evening a banquet to the delegates and representatives.

THE death, at a very advanced age, of Miss C. C. Hopley, daughter of the late Mr. E. Hopley, of Lewes, a naval surgeon, has been recently announced. As regards natural history, the deceased lady, who took special interest in reptiles, of which she kept various specimens as pets, was best known as the author of a popular work on snakes, published in 1882. American birds likewise attracted her attention, and during the Civil War, when she was travelling to collect materials for a work on this subject, she was arrested and imprisoned as a British spy. Miss Hopley was for a number of years a contributor to *The Globe*, many natural history articles in that journal having been apparently written by her pen.

THE authorities of the British Museum are to be congratulated on having acquired, at an almost nominal price, the valuable collection of specimens illustrating the religion of Polynesia, which was long in the possession of the London Mission Society. Many of the specimens are unique, and it would now be quite impossible to form such a collection. Among the most remarkable objects are the great tapering idol of the national god of Raratonga, kept swathed in blue and white matting; Tangaroa, the supreme god of Polynesia, a wooden figure with small human-like objects sprouting from his eyes, mouth, and other parts of his body, typifying his creative power; and a head-dress of black feathers, which completes a mourning costume already owned by the museum. It would have been nothing short of a calamity if a collection of this kind had been dispersed, and the council of the London Mission Society, which has for some time entrusted the objects to the British Museum for exhibition, is to be commended for its liberality in transferring the collection to the nation.

IN reference to the proposal to appropriate a large portion of the ground at the back of the Natural History Museum to purposes other than those of that institution, it is pointed out in the April number of *The Museums Journal* that the Government does not appear to realise the imperative need for expansion which must occur at no distant date if the museum is to do its work properly and keep abreast of the times. Such expansion, it is added, will by no means be confined to galleries and rooms for the exhibition and storage of specimens, but must embrace rooms and buildings in which scientific work in connection with the collections is carried on. Indeed, this latter item will probably be found to be the more urgent of the two. "Nowadays, any museum worthy of the name requires libraries, laboratories, workshops, studios, and so forth, and these often occupy a larger area than the exhibited collections of the museum. The ground that lies between the Natural History Museum and the Science Museum might very well prove none too large for either of these museums alone."

APROPOS of the article on "Standard Bread" which appeared in the last issue of NATURE, Dr. Leonard Hill, F.R.S., publishes a note in *The British Medical Journal* of May 6 on the nutritive value of white and of standard bread. Young tame rats were fed for three weeks some on white and some on standard bread, and for a second three weeks some on white and some on standard flour. Two lots of twenty-five rats each were used and kept in identical conditions; at the start the total weight of each lot was approximately the same. The results were astonishing; ten of the white flour and bread lot died against five of the standard. Taking fifteen survivors of each lot, the standard has a percentage gain in weight of $27\frac{1}{2}$, against twelve for the white in the last three weeks, and at the end nearly all the latter are losing weight, and are less lively and less sleek than the standard. Another lot fed on white flour *plus* an addition of the germ equivalent to that in standard flour, have done as well as on standard flour and bread, suggesting that the germ contains bodies essential for growth or activating enzymes engaged in the digestion of wheat proteins.

IN the House of Commons on May 3, Mr. E. Edwards asked the Secretary of State for the Home Department whether any arrangements were being made to continue the experiments with coal dust which had been carried on during the last three years by representatives of the coal owners and others at Altofts Colliery and elsewhere; and whether the Government were prepared to undertake the control and responsibility of the experiments, in view of their great importance to the mining population in the direction of the prevention of coal-dust explosions. In reply, Mr. Churchill stated that it has been decided to continue the experiments referred to under the supervision of the Home Office, and that the Treasury has sanctioned the considerable expenditure that will be necessary for the purpose. The Mining Association has offered to place at the disposal of the Government for the purposes of the experiments the plant and instrument now in use at Altofts, an offer which has been accepted, and arrangements are being made for starting work as soon as possible on a new site. Mr. Churchill has appointed an expert committee to be directly in charge of the experiments, the members being Sir Henry Cunynghame, K.C.B., Mr. R. A. S. Redmayne, Captain Desborough, Prof. H. B. Dixon, F.R.S., and Mr. W. Cuthbert Blackett. He has also requested the members of the Royal Commission on Mines and of the Coal Dust Committee of the Mining Association, under whose supervision the previous series of experiments was conducted, to act as a consultative committee in connection with the experiments.

MR. J. A. J. DE VILLIERS described the foundation and development of British Guiana before the Royal Geographical Society on May 8. Starting with the first settlement in the early part of the seventeenth century, he traced the gradual growth and development of the colony in the hands of the Dutch for some two hundred years. From 1803 the country became British property, and in 1834 Robert Schomburgk, who had been sent out by the Royal Geographical Society, commenced his travels and explorations which enabled him to lay down boundaries provisional at that time, but which were substantially followed and accepted by the arbitration tribunal in Paris in 1899. The whole subject is an interesting and instructive contribution to colonial history.

Miss Olive MacLeod, who, with Mr. and Mrs. P. A. Talbot, has been exploring the country round Lake Chad for several months, returned to England on Tuesday. The expedition passed up the Niger and Benue Rivers by steamer and canoes through Southern and Northern Nigeria, and then traversed the North Kamerun. French Ubangi was reached in October last. A splendid reception was accorded to the party by the Lamido at Lere. The mysterious falls on the Mao Kahi were located, and have been named Les Chutes MacLeod. After mapping this

part of the river, the party went through the Tuburi Lakes and down the Logone to Fort Lamy. The expedition then proceeded down the Shari to Lake Chad, which was crossed, in Kotoko canoes, from the Shari to Saiyorum. Close studies were made of the various peoples visited, especially of the little-known tribes of French Central Africa and the Badumn of Lake Chad. A large collection of objects of ethnological interest was made, especially of musical instruments, while typical examples of music were taken down. A botanical collection of several thousand specimens has been sent to the British Museum, as also a number of birds, beasts, and reptiles. A route-sketch was made across Lake Chad, and a survey by plane-table and theodolite from Maifoni to Kano.

In a curious paper contributed to the Journal of the Royal Society of Arts for April 21, Prof. H. Chatley discusses Chinese natural philosophy and magic. He endeavours to trace a close analogy between the system advocated by the sage Ch'u Hsi, who lived in the twelfth century of our era, and the discoveries of Sir W. Crookes and Sir J. J. Thomson. Discussing the part played by gambling in magic, he remarks:—"The use of cards is said to be derived from the Turot cards, which were originally employed for occult purposes. The legend which ascribes the invention of cards to the purpose of amusing a mad king does not seem at all a sufficient explanation, and there is, in addition, the fact that cards of a kind existed before the said king. In further support of this idea, the well-known practice of telling fortunes by cards may probably be regarded as a survival of a regular form of divination by such means. It seems, in fact, that card-playing for stakes is a mere development of a ceremony in which individuals consulting the oracle decided to abide by its pronouncements as to the holding of disputed property."

Mr. Dean C. Worcester, Secretary of the Interior under the Government of the Philippine Islands, in an interesting and well-illustrated article contributed to the March issue of *The National Geographic Magazine*, describes the methods by which the American authorities have succeeded in gaining control over, and to some extent civilising, the pagan tribes of northern Luzon. During his tour the officer in charge of the district collects representatives of tribes which are normally in a state of war, and secures peace and the cessation of head-hunting by promoting athletic contests, which are most popular among these savages. They are encouraged to compete in their tribal dances, and the games most popular are running, wrestling, the tug-of-war, and climbing the greased pole. He thus sums up the results of this policy:—"We have been able to get results in dealing with wild men by following the simple policy of always giving them a square deal; by not punishing them for a given course of action unless they had had ample warning that such action would be followed by punishment; by never failing to punish them when, *after due warning*, they have misbehaved; by making friends with them again whenever they were ready to be friendly; and by finding an outlet for their superabundant animal spirits in rough but innocent field sports."

The second number of the Annals of the Cyprus Natural History Society, for 1910, contains a short summary of the more interesting animals observed in the island during the year. A list of Cyprus birds (290 spp.) was published in the first number, and it is proposed to issue shortly lists of the mammals and Lepidoptera.

According to the Indian *Pioneer Mail*, the Bombay Natural History Society is appealing for a sum of 2000*l*. with the object of starting a zoological survey of British India. At present about 8000 rupees have been subscribed, and with this in hand the society has started one collector; but as the services of Mr. Shortridge, who was recently invalided home from New Guinea, are available, it is desired that these should be secured, although this cannot be done without a large increase in the subscription list. It is pointed out that a brief glance at Blanford's "Mammals of India" will show how much remains to be done even in that section of the zoology of the country. Later information states that the sum promised has reached about 10,000 rupees.

In vol. vi., part i., of the Records of the British Museum, Dr. Annandale describes a cirriped of the parasitic group Rhizocephala taken on a crab, *Sesarma thelxinoe*, from a stream 700 feet above sea-level in the Andamans, near Port Blair. The specimen, which is believed to be the only example of the group hitherto obtained from fresh water, is made the type of a new genus and species, under the name of *Sesarmaxenos monticola*. It is pointed out that the crab on which the parasite was found belongs to a group the members of which usually breed in brackish water, if not in the sea, and it is therefore possible that the Andamanese species may periodically visit the ocean to spawn, and that the parasite may have become attached to the type specimen during such a sojourn. "Nevertheless, the fact that the latter contains larvæ in the brood-pouch while living at an altitude of 700 feet entitles it to be included in the fauna of the Indian Empire, and suggests that it is able to flourish in jungle-streams, even if it also occurs in the sea."

In an article contributed to the May number of *Cassell's Magazine*, entitled "The Vandalism of Collectors," Mr. S. L. Bensusan directs attention to the evil effects on the British fauna produced by the recent expansion of nature-study. For it is pointed out that a considerable proportion of those who cultivate this pursuit are not content with acting the part of observers, but join the ranks of regular collectors. This entails a large destruction of birds and their eggs (probably to a great extent illegal), as well as a prodigious slaughter of butterflies and moths, to say nothing of the reckless uprooting of wild flowers. Game-preservers and game-keepers also receive a share of blame, although it is admitted that the latter are worse than the former. In conclusion, the author observes that it would have been better for the wild life of the country if the cult of nature-study had developed side by side with a fuller recognition of the claim of the wild fauna and flora to protection, or with definite legal restrictions on the taking of specimens for private purposes.

At the conclusion of his presidential address to the Quekett Microscopical Club, on some problems of evolution in the simplest forms of life, as reported in the Journal of that body for April, Prof. E. A. Minchin expressed the opinion that in the case of the Protista syngamy is the factor which checks variation among individuals exposed to slightly different external conditions. With such restraining influence a species would tend to break up into different races and strains, either as the result of varying environment or from an innate tendency to divergence. Syngamy, on the other hand, tends to reduce individual differences to a common level. If this be correct, and if it be also true that there is no syngamy among them, it follows that real species do not exist among bacteria, the

members of which must be regarded as strains, without the stability of a species, and liable to modification in any direction by environmental influence. Hence he thinks it "evident that the passage from the bacterial to the cellular grade was perhaps the most important advance in the evolution of living beings. The acquisition of the cellular type of structure was the starting-point for the evolution, not only of the higher groups of the Protista, such as the Protozoa and unicellar plants, but through them of the whole visible everyday world of animals and plants, in all of which the cell is the unit of structure, and which consist primarily of aggregates of cells."

MR. A. R. NICHOLS records (Fisheries Ireland Sci. Invest., 1910, i.) 101 species of Polyzoa from the coast of Ireland, twenty-three of which have not been recorded previously from that coast, and six are apparently new to the British list. Mr. W. M. Tattersall (ii.) describes and figures, from the north-east Atlantic slope, six species of Mysidæ, of which a preliminary diagnosis only had been published, and also defines two new species and two new genera. Four bottom-living species are added to the British and Irish list, two of which were known previously only from the west coast of Greenland. Mr. R. Southern (iii.) contributes observations on certain pelagic Polychæta of the coasts of Ireland, and records *Vanadis formosa*, *Greefia celox*, Callizona (three species), Tomopteris (four species), Travisiopsis (two species), and Sagitella (two species), all of which, except two of the species of Tomopteris, do not appear to have been previously recorded from the British marine area. All these pelagic species live in warm and comparatively highly saline waters of the European branch of the Gulf Stream drift, and are carried therein towards the west coast of Ireland, but only rarely do they cross the 200-fathom line.

THE *procès-verbaux* of the council and sections of the International Marine Investigations, the meetings of which were held in Copenhagen at the end of September last, contain interesting references to observations completed and in progress. Prof. D'Arcy Thompson criticised the investigations on the age and growth of herring as determined from the scales, holding that the number of rings exhibited was subject to individual variation, and did not necessarily give a correct determination of the age of the fish. Prof. Heincke maintained that the method of age-determination by the scale-rings was scientifically sound, and Dr. Hjort stated the reasons for his belief in the trustworthiness of this method, remarking that herring examined in all months of the year showed rings which varied exactly according to the time of the year. Dr. Heincke contributed a summary of the present condition of certain aspects of the investigations on plaice. The spawning conditions of plaice are now well known, various more or less separated spawning places having been found in the southern and northern North Sea, the Kattegat, the Belt, and the Baltic, closely correlated with which are different local races, of which six or seven are distinguished, namely, those associated with the regions just mentioned and others with Iceland and the Barents Sea. Those of the Baltic and Barents Sea are slow-growing races, while those of the North Sea and Iceland are quick-growing races. The recognition of these differences is of great importance in connection with the questions of over-fishing and the plaice-production of different regions of the sea.

PRESENTING in the *Bulletin du Jardin Impériale Botanique*, St. Petersburg (vol. xi., part i.), a list of fungi collected within the government of Samara, Mr. N. N. Woronichin comments upon a new species of Physalospora taken on fruits of Caragana and certain allied species that grow parasitically on species of Astragalus.

ON account of the marked sensitivity of the apex of the coleoptile or first green leaf, oat seedlings are frequently employed for heliotropic experiments, and it has been stated that an incision made in the coleoptile, whatever its orientation, does not prevent the transmission of a stimulus. While offering evidence modifying this statement to the extent that an incision on the posterior side may inhibit the transmission, Mr. P. B. Jensen describes experiments in the *Bulletin de l'Académie Royale des Sciences et les Lettres de Danemark* (No. 1) in which he cut right through the coleoptile, replaced it, and then obtained proof of transmission in the case of stimuli induced by light and also by gravity.

FOREST Bulletin No. 1 of 1911, issued by the Government of India, gives an account of tests of the calorific values of fifty-six specimens of Indian woods carried out by Mr. Puran Singh, Forest Chemist to the Government. The Lewis Thomson calorimeter was used, one kilogram of the wood being burnt in oxygen. The results for thoroughly dried woods lie between 4000 and 5000 kilogram calories per kilogram of wood for the whole of the samples tested. For air-dried wood, which contains about 15 per cent. of water, the calorific power lies between 3500 and 4300 kilogram calories per kilogram of wood. Charcoal prepared from the woods has an average power of 7000 kilogram calories per kilogram.

SYSTEMATIC articles in the *Kew Bulletin* (No. 3) consist of a long series of diagnoses of new tropical African species of Loranthus already enumerated in the "Flora of Tropical Africa," a note on Spatholirion by Mr. S. T. Dunn, and a critical opinion by Mr. T. A. Sprague on the exact status of two saxifrages known as *lingulata* and *lantoscana*, according to which the latter should be regarded merely as a variety of the former. A notable instance of invasion of our southern shores by an alien brown alga, *Colpomenia sinuosa*, is described by Mr. A. D. Cotton. The alga thrives best in sheltered situations, and makes its growth principally in the autumn; persisting through the winter, it produces spores in spring and disappears in summer. On the authority of Lieut.-Colonel A. F. Appleton, a discrimination of the ordinary Transvaal grasses is provided; outside the species of Eragrostis, Panicum, and others well known, *Anthistiria imberbis* and *Chloris virgata* are recommended as fodder plants.

A GENERAL index has been issued for the Journal of the Board of Agriculture in two volumes, dealing with the two periods 1894–1904 and 1904–11. Since the Journal started in 1894, it has maintained a high standard, and has published many articles of permanent value. All these are rendered much more available, now that the general index has appeared, than they were before.

WE are in receipt of the Madras Agricultural Calendar, April, 1911, to March, 1912, issued by the Agricultural College and Research Institute, Coimbatore, containing a number of articles intended for the large and the small agriculturist. In the nature of things, the college is able to play a much more paternal part in the life of the community than would be possible elsewhere, and this publication shows clearly how very extensive are the ramifications of an Indian agricultural department.

THE seasonal distribution of egg production has formed the subject of a biometrical study by Drs. Pearl and Surface, the results of which are published in Bulletin 110

of the United States Department of Agriculture Bureau of Animal Industry. Four cycles were found in the year, the winter period, November to March, wherein egg production is essentially a non-natural (*i.e.* a forced or stimulated) process, the spring period, March to June, this being the natural laying period of the fowl, and two later periods, June to September and September to October. The third period represents in part a natural continuance of the normal breeding period, and in part a stimulated process; it is terminated by the moult, the characteristic feature of the fourth period.

The Harper Adams Agricultural College has recently issued two reports, one dealing with the experiments carried out in the counties of Staffordshire and Shropshire. Numerous field trials are reported in various centres, dealing with the effects of the various artificial manures alone and in various admixtures on the common crops. Some of the proportions are a little difficult to understand; one of the mixtures, for instance, being composed of 1½ cwt. of one constituent, 3⅛ cwt. of another, and 1⅝ cwt. of a third. Unfortunately no soil analyses are given, nor are there any meteorological data for the various centres, so that discussion of the results is not possible. At the college itself, work has been continued on the "wart" disease of potatoes caused by the fungus *Synchitrium endobioticum*, Percival, not the least interesting feature of which is that certain varieties of potato are immune, whilst others, in the same conditions, are attacked.

In *La Géographie* (No. 3, 1911), M. N. Villate gives an account of his recent journeys from Tidikelt to the Niger by the Ahaggar, and adds to our accurate knowledge of the French Sahara. His object was to extend the network of astronomically determined positions, and he succeeded in obtaining the latitude and longitude of forty-nine points. Equal altitudes of stars were observed for latitude and chronometer correction; longitudes were obtained when practicable by occultation of stars, and chronometer watches furnished a means of determining the difference of longitude between neighbouring points on the route. Observations were also made of the magnetic declination, inclination, and horizontal force at some thirty-five to forty points from Biskra in the north to Gao on the Niger in the south. In consequence of changes which were found to have taken place in the magnetic moment of the magnets during the journey, values of the horizontal force can only be given to three places of decimals of C.G.S. units.

Miss Georgina King has reprinted several newspaper articles in a pamphlet entitled "The Mineral Wealth of New South Wales and other Lands and Countries" (Sydney: Brooks and Co.), with some additional matter and a personal introduction. Her main contention is that the ore-deposits were connected with volcanic activity, which was especially prevalent in Tertiary times. Man, however, is said to have existed in Australia in "the early Tertiary period," and to have acquired a wandering propensity from the mental shocks then received. Glossopteris is said to be in Europe exclusively a Mesozoic plant. Waterspouts over oceans are attributed to "upheavals of subsided metamorphic matter." We can understand the writer's assertion that geologists in Australia have objected to the publication of such papers in scientific journals; but we can scarcely believe, as is alleged, that their motive was a fervent desire to issue the results under their own names.

The Italian Seismological Society has issued a volume of notices of the earthquakes observed in Italy during the year 1907. The volume is compiled by Dr. G. Martinelli, assistant in the R. Ufficio Centrale di Meteorologia e Geodinamico at Rome, and forms the appendix to the fourteenth volume (for 1910) of the *Bollettino* of the Seismological Society. Twenty years ago, such notices were contained in a few sheets of the *Bollettino Meteorico* of the central office. When the Seismological Society was founded in 1895, they were issued in detachments with each part of the *Bollettino*. Published, as they now are for the first time, in a separate volume of nearly six hundred pages, we can form some idea of the magnitude and value of the work, for the editing of which Dr. Martinelli is responsible. Among the most interesting of the notices are those on the Calabrian earthquake of October 23, 1907. These form the foundation of the report that will shortly be issued by the Government Commission on this violent, if somewhat restricted, shock.

The monthly meteorological chart of the North Atlantic, published by the Meteorological Committee for May (first issue), includes useful synoptic weather charts of that ocean for April 6–12 (commencing with the day following the blizzard experienced in this country). They show that during nearly the whole of the period in question there was an area of high barometric pressure outside our north and north-west coasts, and that it extended at times to the mid-Atlantic. This distribution of pressure explains the severe weather over England and France, which was accompanied by frequent showers of snow and sleet. As the central part of the anticyclone extended southward the weather became finer. The chart of the Indian Ocean for the same month contains an interesting communication on phosphorescent seas from Admiral Tydeman, of the R. Netherlands Navy (see Nature, March 16). We note that the chart has been further improved, and extended to the eastward.

A new method of producing the line spectra of a metal, which promises to facilitate greatly the study of the subject, is described by Dr. G. Gehlhoff in the *Verhandlungen* of the German Physical Society for March 30. It makes use of the fact that the inactive gases, helium, argon, &c., are spectroscopically extremely sensitive to impurities, their lines disappearing from the positive glow of the vacuum tube if small quantities of air or water vapour are present. A small quantity of the purified metal to be investigated is introduced into one of the ordinary spectral tubes, and the tube washed out with, and finally filled with, helium. On passing the discharge the tube may or may not give the lines of the metal in the positive glow, but on heating it, a temperature can always be found at which the lines appear, and a higher temperature at which the helium lines disappear completely. These temperatures are respectively, for cæsium, 50° and 70° C.; for sodium and potassium, 80° and 140° C.; while for mercury the temperature of the room is sufficient to produce the lines of the metal.

The March number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* contains the first instalment of a lecture on the electrification of railways, delivered before the society in November last by M. de Valbreuze. After giving a short history of the slow progress of electrification previous to 1905, and its rapid extension since that date, the author describes the principal features of the systems at present in use under the heads:—Direct current 500–700 volt systems, triphase systems, monophase systems, and direct current high-pressure

systems. As the article is well illustrated and deals to a large extent with installations less well known in this country, it will prove of great value to those who wish to get a bird's-eye view of the present state of the problem of electrification of railways. Subsequent articles will deal more in detail with the conditions under which electric traction is advantageous, and the relative merits of the various systems.

We learn from an illustrated article in *The Engineer* for April 28 that the 9,000,000-gallon water tank, constructed by Messrs. Clayton, Son and Co., of Leeds, for the water supply of Calcutta, is now finished. This tank is 321 feet square and is 16 feet in depth. The height from the top of the tank to ground level is 110 feet; the tank is supported by a large number of braced steel columns. The tank is divided into four compartments by cross frames, each of which can be used independently, so that one or more compartments can be put out of service for cleaning or repairs without interrupting the service from the others. The tank is constructed of steel plates ⅜ inch in thickness and is thoroughly stiffened. The tank is roofed in, the roof overhanging the tank by 12 inches. Plates and brass wire gauze are fitted in order to prevent birds, &c., from gaining access to the tank. The tank had to be made absolutely watertight by the terms of the contract, and this has been carried out successfully.

The Cambridge University Press has published separately, price 3*s*., the exercises from Dr. C. Davison's "Algebra for Secondary Schools," which was reviewed in Nature on November 19, 1908 (vol. lxxix., p. 65).

Messrs. Witherby and Co. have in the press and will shortly publish an illustrated travel book, entitled "Through South Westland," by Miss A. M. Moreland, being a chronicle of a ride through a district in New Zealand which is little known to the outside world.

The latest ornithological catalogue of Messrs. John Wheldon and Co., 38 Great Queen Street, London, W.C., which has been received, is conveniently arranged under countries. It includes particulars of the books from the library of an eminent ornithologist lately deceased, and selections from several other important libraries. The catalogue gives details of 1450 books and papers.

The Royal Insurance Company, Ltd., of Liverpool, has issued the eighth edition of "Records of Sports." Among its new features may be mentioned the section dealing with aviation, which provides full information, up to the end of 1910, of notable performances and other events in connection with aviation. The details provided in connection with many sports have been greatly amplified. Copies of this interesting book of reference may be obtained, so long as the supply lasts, by applying to the manager of the company at 1 North John Street, Liverpool.

Erratum.—In the abstract of a paper read before the Royal Society of Edinburgh, printed in Nature of April 6, p. 200, second column, line 8 from bottom, the ^{n} in the formula $y^{n}(x+a)$ was omitted. The formula was printed exactly as it was in the type-written copy supplied by the reporter, and the error was unfortunately not noticed by him in proof.

OUR ASTRONOMICAL COLUMN.

Meteoric Fireballs and Meteors.—On April 30, at 11.58 p.m., the Rev. T. E. R. Phillips, of Ashtead, Surrey, saw a fine meteor about three times as brilliant as Jupiter. It was directed from Virgo, and disappeared in 206° + 14°, only the end course of about 3 degrees being observed.

On May 2, at 10.53, Mr. J. H. Elgie, of Leeds, saw a fine meteor equal to Venus descending from 2° above β Serpentis to 4° above β Libræ.

On May 4, at 8.52 p.m., Mr. S. A. Wilson, of Reigate, Surrey, witnessed the flight of a magnificent meteor from the Polar star to a few degrees below Capella. Its light was estimated as three times the apparent lustre of Venus. It left a long train in its wake, and moved with fairly slow speed. The radiant point was probably in the eastern sky at about 247° + 2°, as there is a very active shower of bright meteors from this point in May, and the direction of the fireball of May 4 is nearly conformable with this stream.

Mr. F. T. Naish, of Bristol, watched the eastern sky on May 4, 14h. to 15h., and saw eight fairly bright meteors. Three of these were conspicuous from their streaky trains and very long flights, and they were directed from the radiant point of Halley's comet. The paths intersected at 338° − 2°. The shower of Aquarids supposed to be associated with the famous comet referred to has certainly returned this year, though not in special abundance according to the reports already received.

The Total Eclipse of the Sun.—Major Hills, secretary of the Joint Permanent Eclipse Committee, has, according to *The Times* of May 5, received a telegram from Father Cortie stating that thick cirrus clouds persisted at totality, but photographs of the corona and spectrum were obtained; the corona was characteristic of the minimum sun-spot period.

A telegram received by the Astronomer Royal from Mr. Worthington, who was also stationed at Vavau, reads:—"Splendid photos, inner and outer corona, one and a half degrees."

A later communication states that Mr. C. L. Wragge, formerly meteorologist to the Queensland Government, saw the eclipse under excellent conditions at Lifuka, Friendly Islands. Hydrogen prominences were wonderfully distinct, and, apparently, a four-vaned corona was seen extending some distance from the moon's disc.

Spark Spectra of Calcium and Hydrogen in a Magnetic Field.—Some results possibly of great importance in the study of solar physics are published by M. Hemsalech in the *Comptes rendus* for April 24 (vol. clii., No. 17, p. 1086).

M. Hemsalech finds that when a spark is passed perpendicularly to the lines of force in a strong magnetic field, the enhanced lines in the spectrum of the spark behave differently from the arc lines. When the spark passes between calcium poles, in a field of from 4000 to 6000 C.G.S., it is violently projected in a sheaf at right angles to the lines of force, and a spectroscopic examination of this sheaf shows that the line at λ 4227 is as long as H and K; the spectroscope is pointed parallel to the lines of force. When the spark is passed in a strong transverse current of air, without a magnetic field, the 4227 line is much longer than H and K.

But when the spark is passed, in the magnetic field, in an atmosphere of hydrogen, a remarkable change takes place, for whereas the respective heights of the H and K lines were 22·6 and 23·7 cm., the 4227 line was only 16·3 cm.; the heights of the hydrogen lines were Hα 21·4, Hβ 20·0, Hγ 18·8, and Hδ 16·3 cm. The spark lines at λ 3706 and λ 3737, in the vicinity of the poles, are also higher than the arc lines λ 4283 and λ 4455. In an atmosphere of oxygen, however, the 4227 line is as long as H and K, and if a weaker current, 800 C.G.S., is employed, it becomes longer and stronger than they.

M. Hemsalech tentatively suggests an analogy with the solar conditions. A mass of hydrogen atoms carrying electric charges, and travelling parallel to the solar surface, might, in the magnetic field around a spot, become violently projected, as in the laboratory, and carry with it to as great or a greater height the calcium vapour so abundant in the solar atmosphere; this could not happen immediately over a spot nucleus, for there the lines of force are perpendicular to the solar surface.

The Solar Constant.—Messrs. Abbot and F. E. Fowle, jun., discuss the value, during recent years, of the solar constant of radiation in No. 3, vol. xxxiii., of *The Astro-*

physical Journal. Two outstanding questions regarding the work are now settled. The first was the true pyrheliometric scale, which, as pointed out in these columns on April 20, they have now decided upon. The second was that of carrying the energy-spectrum observations further into the ultra-violet, with the prospect of increasing the values of the constant previously given, and this has now been done. During this work it was discovered that a region containing considerable energy in the ultra-violet was neglected in the 1905–6 observations, but a special investigation shows that there is no need to raise the value of the solar constant obtained for that period; the published coefficients of atmospheric transmission for 1905–6 are, however, all about 1·4 per cent. too low.

The values of the constant derived from the 1905–9 Mount Wilson results indicate a range of solar variability within a range of 8 per cent., which does not appear to be accidental, and the agreement of the results obtained at different altitudes discounts the probability of this variation having an atmospheric origin. The mean value of the solar constant obtained for the period 1905–9 was 1·922 calories (15° C.) per square centimetre per minute, and this is probably correct within 1 per cent. The most likely explanation of the 8 per cent. variation is that there are really variations of 0·03 stellar magnitude in the solar radiation outside our atmosphere.

PHOTOGRAPHIC OBSERVATIONS OF SOLAR PROMINENCES.—Valuable additions to our knowledge concerning the sun's atmospheric disturbances are likely to accrue from the systematic study of the spectroheliograms showing solar prominences. The results of such a study are published in No. 2, vol. xxxiii., of *The Astrophysical Journal* by Mr. G. Abetti and Miss R. E. Smith, who have reduced a large number of spectroheliograms taken at the Mount Wilson Observatory, and compared the prominences with those shown on photographs taken at the Yerkes Observatory and with those observed visually at Catania. The comparison of the Hα and the calcium-light photographs *inter se* and with the Catania hydrogen observations reveals several points of interest. Among these it would appear that the calcium vapours rise to greater heights than those of hydrogen, a feature shown both in the measures of heights and of areas. The mean height (56″) of the Mount Wilson calcium prominences is about 7″ greater than the mean height of the hydrogen prominences observed there and at Catania. It would also appear that the calcium prominences have a slightly different distribution from those of hydrogen. Results for the period 1906–8 are tabulated and plotted, and one or two special cases of interrelation with disturbed areas are discussed.

THE MOVEMENT OF STARS OF THE ORION TYPE.—In a paper published in the *Bulletin de l'Acad. roy. de Belgique* in 1910, Dr. Stroobaut directed attention to the different values obtained for the sun's velocity through space when it was derived from the radial velocities of Orion stars from when it was derived from the velocities of other stars; since then Profs. Frost and Kapteyn, using different coordinates for the apex, have disclosed a similar difference. Dr. Stroobaut has recalculated his values with their value for the apex, and finds that his new results show practically the same difference as theirs. He obtains for the solar velocity 19·25 km. when using all stars, and 21·8 km. for the Orion-type stars; the latter is divided into 16·0 km. in the region of the apex and 26·2 km. near the antapex (*Bull. de l'Acad. roy. de Belgique*, No. 1, p. 30).

EPHEMERIS FOR ENCKE'S COMET NEAR PERIHELION, 1911.—In No. 39 of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo* Dr. Backlund discusses the orbit of Encke's comet during recent years, and tabulates the several perturbations it has suffered since its apparition in 1898; these are very small. He also gives a revised set of elements, from which he has prepared an ephemeris covering the period of perihelion passage and extending from July 1 to September 21; the return is not a favourable one for observations.

THE CATANIA OBSERVATIONS OF SUN-SPOTS AND FACULÆ, 1910.—Prof. Riccò's annual tabulated summary (1910) of the spots and faculæ observed at the Catania Observatory appears in No. 3, vol. xl., of the *Memorie di Astrofisica ed Astronomia.* The values for the year show that the solar activity is still declining. The mean daily frequency of spots was 1·7, and on 104 days (35 per cent.) no spots were recorded.

THE ROYAL PHOTOGRAPHIC SOCIETY'S EXHIBITION.

THE Royal Photographic Society is holding its annual exhibition in the spring instead of the autumn this year, and in the hall of the Prince's Skating Club, Knightsbridge. The exhibition is open now and closes on the last day of this month. Queen Alexandra has graciously contributed sixteen of her own photographs, and surrounding these there is a very large collection of portraits of King Edward VII. As these date from about 1853, they may be studied both as a pictorial history of our late King, and also as representative of the development of photographic portraiture from the early days of the collodion plate. Entomologists and microscopists will be pleased to see a fine portrait of Mr. Fred. Enock, by Furley Louis, in the same gallery.

There is a large collection of autochromes, with here and there among them colour transparencies by other analogous processes. By daylight they are excellently shown, and indicate that the number of those who employ these processes for the photography of colour is rapidly increasing, and that the general results are far more successful than they were a year or two ago. Sir W. J. Herschel and Mr. J. H. Gear both show photographs of rainbows, which are very different from the poor representations that the best of monochrome photography can render of them. There is some notable photomicrographic work in colour, especially various minerals and crystals shown between crossed Nicols, and among Prof. Waymouth Reid's collection there are a few examples of high-power pathological work.

The general natural history section is not very extensive, but includes several "life-histories" of moths, butterflies, tadpoles, and, by Mr. William Farren, a series of twelve prints illustrating the nesting period of the nightjar. The "Great American Egret," by Mr. Hugh C. Knowles, and "Gannet going down wind," by Mr. Oliver G. Pike, are of special interest at the present time.

The scientific section is larger than it has been lately. This branch of the subject can never be adequately represented, because only a small proportion of the scientific work done is suitable for an exhibition, but this year the society has been successful in getting together an excellent collection. High-power photomicrography is well represented. Dr. T. W. Butcher's *Navicula Smithii* and *Coscinodiscus asteromphalus*, and Dr. Duncan J. Reid's Trypanosomes are specially noteworthy. Mr. Charles R. Darling shows a series of photographs of drop formation taken comparatively slowly, with exposures of one-tenth of a second instead of, as heretofore, in a few millionths of a second. The drops are of aniline oil in water. Among the radiographs, the series by Dr. Thurston Holland represents probably the finest work at present possible in this direction. Ten lantern slides of a normal stomach, taken by Dr. F. Haenisch with a Rœntgen-cinematographic apparatus, show the peristaltic wave moving down the great curvature. Prof. Zeeman contributes an illustration of his recent work on the effects of a magnetic field on the absorption sodium spectrum lines, and Prof. R. W. Wood sends some of his photographs of landscapes taken with the infra-red radiations. Dr. George H. Rodman shows photomicrographs of the pollen cells of fifty different flowers, and also a series of stereo-photomicrographs of natural history and botanical subjects, which represent some small objects, such as diatoms, in a realistic way that is very rarely seen.

Among the astronomical exhibits that will be studied with interest are fifty transparencies by Dr. Max Wolf, of Heidelberg, of various comets and nebulæ with their spectra, photographed under different optical conditions, and an extensive series of photographs of planets and comets and their spectra, lent by the Lowell Observatory. Of the many other noteworthy subjects we can only refer to illustrations of rotary photogravure in its applications to newspaper illustration and three-colour printing, shown by Mr. A. J. Newton, the principal of the London County Council School of Photo-engraving.

GEOLOGICAL WORK IN BRITISH LANDS.[1]

III.—IN CANADA.

THE Geological Survey Branch of the Canadian Department of Mines has a large amount of pioneer work before it. In a publication numbered 1097, issued in 1910, Mr. J. Keele describes his reconnaissance across the Mackenzie Mountains in Yukon and North-West Territories, involving much personal risk and often dependence on hunting for a supply of food. The country that he explored along its rivers lies between the Mackenzie Mountains, a part of the Rocky Mountain axis, and the St. Elias Range. The valley bottoms are practically free from frost during June, July, and August; but the temperature varies from well below zero in January to 90° F. during the almost continuous daylight of June. Cambrian, Silurian, Devonian, Triassic, and Cretaceous strata have been recognised, and Mr. R. G. McConnell has described a basin of Cainozoic rocks, including basalt. Granite, intruded in local "stocks or pillars" (p. 41) into old sediments, is responsible for Mount Sheldon and other upstanding peaks of the Mackenzie Mountains (Fig. 1). The map accompanying the memoir, like the illustrations, is a fresh contribution to geography.

FIG. 1.—Mount Sheldon, Mackenzie Mts., a granite mass intruded into Palæozoic sediments.

Mr. W. McInnes reports (No. 1008) on a part of the North-West Territories drained by the Winisk and Attawapiskat Rivers, with a large map on the scale of one inch to eight miles, geologically coloured along the rivers traversed. Topographical surveys were made during journeys by canoe. This region, lying north of the Ontario border, has no great relief; the Archæan plateau has been smoothed by glaciation, and much of the lowland is covered with boulder-clay, in which the streams now cut characteristic vertical cliffs. Post-glacial marine clays, with *Pecten islandicus*, *Mya truncata*, and *Mytilus edulis*, those widely spread molluscs of the north, occur in the valley of the Winisk, presumably representing an inflow from Hudson Bay. Lists of living land and fresh-water shells are given on pp. 52 and 53, and will be sought for here only by those zoologists who know the observant outlook of the Canadian Department of Mines. Its Memoir 14-N, by the by, is devoted to new species of marine shells dredged off Vancouver Island. In a report bound up with that on the Winisk area, Mr. A. Wilson describes a traverse from Lac Seul to Cat Lake, across an unexplored area of 15,000 square miles in extent, to the west of that examined by Mr. McInnes. The rocks consist of amphibolites and mica-schists, penetrated by granitoid gneisses on the south, the latter containing inclusions of amphibolites. Here, as so often happens, the schistose rocks, with their metamorphosed basic associates of igneous origin, are the oldest recognised in the district.

Mr. W. H. Collins's account (No. 1059) of the geology between Lake Nipigon and Clay Lake, Ontario, is remarkable for its clear acceptance (p. 52, &c.) of the intrusive relation, over wide areas, of the Laurentian to the Keewatin and Huronian series. Inclusions of the latter in the gneisses, far away from any junction of the two types of material, are used as an argument for the former extension of a schistose mantle over the whole area. It may be confidently stated that in our islands such inclusions would be often treated under the mysterious title of "basic segregations."

The Survey now (1910) issues a definite series of publications styled Memoirs, No. 1 being by Mr. A. Wilson on the geology of the Nipigon Basin. In Lake Nipigon we are glad to note the occurrence of Murchiston, Geikie, and Kelvin Islands, all constructed of firm crystalline rock. These are parts of the great and almost horizontal sheets of diabase which cover a wide area, and which remind one of similar occurrences in the Karroo systems of South Africa. After a full discussion, the author concludes that the capping diabase in his area represents a lava that flowed over a land-surface of great extent, to which it is unconformable, and from which, at certain points, it has gathered boulders (p. 94). The sedimentary series of shales, sandstones, and dolomites, in which the igneous sheets are intercalated, are at present classed as Keeweenawan, but Mr. Wilson thinks (p. 71) that they may be younger than even the Potsdam series farther east. The gneisses that occur below the Huronian series include basic types that "probably represent highly metamorphosed portions of the cover, or rather are new rocks whose constituents in part were derived from the cover, and in part from the granite magma" (p. 57). Many features of the surface that might have been attributed to glacial erosion are found to pass under the diabase sheets, and the author regards the ice in this area as comparatively unimportant from a moulding point of view.

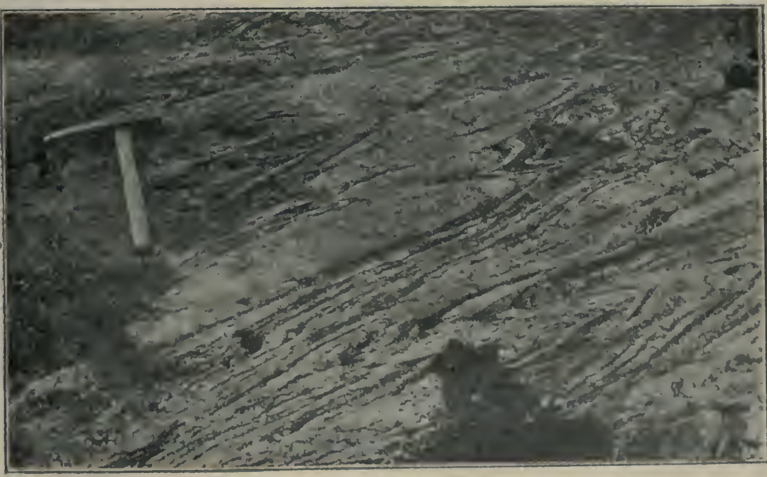


FIG. 2.—Gneiss formed from red granite and amphibolite, with contortion due to flow, and a tendency to produce a second direction of banding. Near More Falls, Ontario.

Mr. D. Cairnes, in Memoir 5, writes on the coal district of the Lewes and Nordenskiöld Rivers, the latter

[1] The second article appeared in NATURE of April 27 (p. 292).

being a tributary of the former, and both draining ultimately into the Yukon. The coals are of Jurasso-Cretaceous age. The physiography and natural history of the district are described, and the summer months are said to be delightful. The drift-filled valley floors, set with little lakes, are likely to attract stock-raisers and even cultivators.

Messrs. F. D. Adams and A. E. Barlow furnish an important memoir of some 400 pages (No. 6, price 30 cents) on the Haliburton and Bancroft areas of Ontario. This region is part of a great elevated plain, dissected into moderate and rolling hills, and formed of Laurentian granite-gneisses, with inclusions of amphibolite. The authors give conclusive reasons for regarding the latter masses as derived from the roof or walls of the granite batholith; the blocks fell into the magma, and partook of its subsequent movements (p. 121). Frequently they become streaked out, until strongly banded and even contorted gneisses are produced (Fig. 2); but the authors hesitate (p. 123) to urge that all the grey gneiss of the district has originated in this composite way. The amphibolites, even on a large scale, are traced to the contact-alteration of limestones by the granite, with perhaps some intermingling from the igneous magma. This is, of course, what has been urged in many other areas; but the broad exposures in these undulating Canadian lands offer unusual opportunities for demonstration. Many other types of crystalline rock are described, including syenites with corundum, and the whole memoir is one of immense interest to the petrographer. The corundum is worked commercially (p. 371).

Mr. J. Dresser describes St. Bruno Mountain, in Quebec, in Memoir 7, a mass of ultrabasic igneous rock intruded into Ordovician rocks, probably in Devonian times. Mr. D. Dowling deals, in Memoir 8-E, with the promising field of Cretaceous and Cainozoic coals at Edmonton, on the Saskatchewan, in the north-west.

Memoir 3 is a quarto by Mr. L. M. Lambe on Palæoniscid fishes from the Albert Shales of New Brunswick. The author correlates these beds (p. 14) with the Scotch Calciferous Sandstone. He figures, among other specimens, the types that were described by C. T. Jackson, without illustrations, in 1851.

Mr. C. D. Walcott (Smithsonian Miscell. Collections, vol. liii., No. 7, 1910) has carried his studies of Cambrian stratigraphy into the Bow River Valley, Alberta, Canada, a highly picturesque and mountainous region, where he finds that the basal Cambrian beds rest unconformably on unaltered pre-Cambrian shales and sandstones.

Perhaps we may mention here, in conclusion, a paper by Mr. R. Guppy, published in Canada (Trans. Canadian Institute, vol. viii., p. 373), on "The Geological Connections of the Caribean Region." Mr. Guppy, writing from Trinidad, discusses deep-water Cainozoic beds in Jamaica and other islands, and argues for a former "land connection between the Caribean and North Africa and a sea connection between the Caribean Sea and the Pacific." Both these probably passed away at the close of Miocene times. Mr. Guppy has a way of abolishing double letters in generic names, which may be American, but is hardly fair to their originators.

G. A. J. C.

PRESSURE IN STELLAR ATMOSPHERES

WITHIN the last fifteen years the spectroscopic equipment applied to the study of both laboratory and celestial investigation has been very materially modified both in dispersive power and design. In the early 'nineties there were very few of the 21·5-feet Rowland concave grating spectrographs in regular commission for terrestrial research, and it is probably safe to say that no stellar spectrographs were in use giving direct spectra comparable in dispersion with Rowland's solar spectrum.

The transference of Dr. G. E. Hale's sphere of labours from the Yerkes Observatory to the new solar observatory on the summit of Mount Wilson, Pasadena, California, in 1905, however, marks an important epoch in the progress of spectroscopy, as from that time may be dated the successful application of high dispersive spectrography to the problems of celestial and terrestrial identification, both chemical and physical. Many of the beautiful discoveries have already been noted as they were announced: the photography of sun-spot spectra on a sufficiently large scale to serve as a standard map for future reference, the magnetic field accompanying the sun-spot vortices, the detailed laws of solar rotation, all giving an enormous mass of detailed evidence from which fruitful discussions may be profitably initiated. In the examination of certain of the solar photographs numerous peculiarities were noticed in the relative wave-lengths of the lines, indicating the operation of a definite law. Some time previously Halm had announced (*Astronomische Nachrichten*, Bd. 173, p. 273, 1907) that certain iron lines were relatively displaced to the *red* at the sun's limb compared with their position at the sun's centre. In 1910 Hale and Adams described the results of a long series of determinations of these minute displacements made with the spectrograph attached to the tower telescope of the solar observatory (*Astrophys. Journ.*, vol. xxxi., p. 30, 1910). After eliminating all the known differences owing to rotation and orbital motion, they found from an examination of 470 lines between λ 3741 and λ 6573 that the residual displacements could be classified to a certain extent. Thus the hydrogen lines, calcium (H, K, 4227), sodium D, and magnesium *b* lines showed no appreciable displacements, and this was also the case with the lines the intensities of which were greatly strengthened at the limb of the sun. The lines of titanium, vanadium, and scandium show considerably smaller displacements than the lines of iron and nickel.

The elements of high atomic weight, such as lanthanum, cerium, in general exhibited very small displacements.

The *enhanced* lines, as a class, showed decidedly *larger* shifts than the corresponding *arc* lines.

All these facts point to the suggestion that they are caused by the varying pressure in different parts of the sun's atmosphere, and it will thus be readily seen how, by a careful study of these interrelations and the laboratory variations known to exist under different modes of treatment, we may find it possible to arrive at a satisfactory explanation of the mechanism of the solar atmosphere.

Now to the astrophysicist the sun is simply our nearest star, presenting to us special facilities for local selective examination by reason of the fact of its having a disc of appreciable diameter, and furnishing abundance of light. When the problem is extended to the case of stellar atmospheres the difficulties are at once greatly increased.

It was to afford the means of attacking this question in an efficient manner that Dr. Hale planned the installation of a very high dispersion spectrograph to be used with the new reflecting telescope of 60 inches aperture which has been so perfectly designed, constructed, and adjusted into working trim by Prof. G. W. Ritchey. With the new spectrograph, the spectra of several of the brighter stars have been successfully photographed, and from a preliminary study of those of α Canis Majoris (Sirius), α Canis Minoris (Procyon), and α Böotis (Arcturus), Mr. W. S. Adams has been enabled to come to some interesting conclusions respecting the conditions existing in the atmospheres of these stars (*Astrophys. Journ.*, vol. xxxiii., p. 64, 1911; Contributions from the Mount Wilson Solar Observatory No. 50).

By means of subsidiary mirrors, the equatorial reflector is employed in the *coudé* form, the light being reflected down and through the hollow polar axis to the slit of the spectrograph. The equivalent focal length of the combination of mirrors is 150 feet (45·7 metres), giving an aperture ratio of 1 : 30.

For convenience of manipulation and constancy of temperature, the spectrograph was arranged vertically downwards in an underground pit. The spectrograph is of the Littrow or auto-collimation type, consisting of a lens of 15·2 cm. aperture and 5·5 metres focal length, used in conjunction with a dense flint-glass prism of 63° angle, and a plane mirror to send the light back through the prism, thus giving the equivalent dispersion of two prisms. The large scale of the dispersion thus provided will be evident from the approximate linear equivalents, given as follows:

At λ 4300, 1 mm. on photographic plate = 1·4 A.
,, 5000, ,, ,, ,, ,, = 2·4 A.
,, 6500, ,, ,, ,, ,, = 6·2 A.

Satisfactory definition is obtained throughout the whole length (43 cm.) of the plate used in the spectrograph camera. In the more refrangible portions of the spectrum Lumière "Sigma" plates were employed, while from λ 4900 to the red end Seed "Gilt Edge 27" plates sensitised by Wallace's formula were used. For comparison the spectrum of the iron arc was photographed alongside the star spectrum.

Six plates of the spectrum of Sirius (λ 4200 to λ 6600), four of the spectrum of Procyon (λ 4200 to λ 4900), and nine plates of the spectrum of Arcturus (λ 4300 to λ 6600) were available for measurement, and the chief object in the study of these spectra has been to test the possibility of detecting any differences of displacement for the different lines, and thereby obtain some idea of the effective pressure in the atmospheres of the stars. In Sirius the number of lines available for measurement was comparatively small; in the case of Procyon and Arcturus the selection of lines was similar to those used in the investigation of similar displacements of the lines in the spectrum of the sun's limb.

The enhanced metallic lines, it will be remembered, show as a class most definitely larger shifts at the sun's limb than the ordinary arc lines. Now in the spectrum of Sirius the enhanced lines form a prominent feature, while the arc lines are few. In Procyon the enhanced lines are less prominent, while the arc lines have become more pronounced. In Arcturus the enhanced lines are almost evanescent, while the arc lines, which are associated with the spectrum of sun-spots, are very strongly developed. Mr. Adams gives a table showing in summary form the main results of the inquiry, from which it is seen that in all cases the enhanced lines show a decided displacement to the red relative to the arc lines. Giving the displacements as radial velocities in kilometres, we may summarise the results as:—

Sirius: Enhanced—Arc Lines = +0·90 km. = +0·014 A
Procyon: ,, ,, ,, = +0·58 ,, = +0·009
Arcturus: ,, ,, ,, = +0·08 ,, = +0·001

The behaviour of the prominent lines in Arcturus is so definite that a special discussion is given of them. A large proportion of the lines of titanium, vanadium, and calcium are greatly strengthened, the enhanced lines decidedly weakened, and those of iron and chromium either strengthened or weakened according to their temperature gradation. The lines of nickel appear to be more prominent in the star spectrum than in sun-spots. The following table summarises this discussion:—

Element	Displacement Å	Equivalent Velocity km.
H	−0·020	−1·2
Ca	−0·017	−0·70
Mg	−0·011	−0·68
V	−0·006	−0·24
Ti	−0·006	−0·23
Ni	−0·006	−0·22
Fe	+0·006	+0·25

The shifts evidently suggest definite grouping of similar elements. The iron lines show a shift towards the red compared with all the other elements examined.

Such is the material Mr. Adams provides for his investigations. In the absence of any other known probable cause, he considers pressure as the principal agent causing these systematic displacements in stellar spectra. The laboratory experimental results of Humphreys and others gave as an average shift for the arc lines of iron 0·0025 Å per atmosphere of pressure. At the sun's limb the enhanced lines in the more refrangible portion of the spectrum were found to be shifted approximately 50 per cent. more than the arc lines, and recent work by Mr. Gale on the spectrum of titanium indicates that the enhanced lines of this substance are also shifted more than the arc lines at the same pressure. Assuming, then, that a similar relationship exists between the enhanced and arc lines of other elements, this affords a means of estimating the gravitational pressures in the atmospheres of stars the spectra of which show these displacements. Thus, as seen in the table quoted above, the enhanced lines in the spectrum of Sirius are shifted towards the red relative to the arc lines by 0·014 Å. This would correspond to a pressure of 12 atmospheres in excess of that existing in the sun's reversing layer. Similar reasoning in the case of Procyon indicates a pressure of 7 atmospheres over that of the sun's reversing layer. These results appear to be in accord with the modern view of regarding stars of the Sirian type as possessing no true photosphere, being simply a mass of gas increasing in density towards the centre without any surface of discontinuity or condensation. In such a star the light coming from great depths would most probably be visible from outside, and indications of great pressure would then be expected. In Procyon the spectrum indicates a transition stage between Sirius and the sun, and the pressure is shown intermediate also. It should be noted here, however, that one of the most important cases investigated by Humphreys in his work on pressure effects is directly opposed to the above conclusions. He found that in the case of calcium the blue *g* line was shifted by pressure about *twice* as much as the H and K violet lines. Now the behaviour of these lines in the laboratory, and also in the spectrum of the solar chromosphere, indicates that H and K are typical *enhanced* lines, while 4226 (*g*) is a very typical *arc* line. The differential pressure effect on the enhanced and arc lines of strontium was exactly similar to that of calcium, viz. the enhanced lines were shifted *less* than the arc lines. Unfortunately for this discussion, Humphreys only employed the arc spectrum in his pressure investigation, so that the general behaviour of the enhanced lines of other substances than calcium and strontium cannot be inferred from his results.

Passing on to the conditions of pressure in Arcturus, it is pointed out that the facts indicate the existence of a well-formed photosphere, the light from which proceeds from relatively low-pressure areas at moderate depths. The results for the lines of different elements indicated in the table are similar to those found for the solar lines. Thus in the sun hydrogen rises to very great heights, calcium and magnesium also being high-level substances. Titanium is also relatively high-level, but iron is distinctly a low-level element. In Arcturus the displacements indicate exactly such an arrangement, and it is thus concluded that the lines of H, Ca, Mg, Ti, &c., are subject to less pressure than those of iron, and therefore that the gases producing them lie at a higher average level.

CHARLES P. BUTLER.

RECENT INVESTIGATIONS ON SOIL FERTILITY.

FOR some years past the United States Department of Agriculture Bureau of Soils has maintained that infertility might, and not unfrequently does, arise from the presence in the soil of toxic organic substances that have been excreted from the roots of plants. This view has been opposed on two grounds: it is not evident that plants do normally excrete poisonous substances; and if such substances are present there is no proof that they would act as poisons in the soil, which possesses a remarkable power of withdrawing dissolved substances from solution. Not long ago Scheiner isolated dihydroxystearic acid from a considerable number of unproductive soils, and now, in conjunction with J. J. Skinner,[1] he has examined its behaviour to plants in water cultures. In all cases its effect was toxic, but the toxicity was much reduced when fertilisers were added to the solution, and was at a minimum when the fertilising constituents were present in the ratio most favourable to plant growth. Several incidental questions were also cleared up dealing with water cultures—perhaps the most difficult of all experiments to interpret—and the paper contains a great number of data bearing on the subject. The behaviour of this acid in the soil is not touched upon, and very wisely no attempt is made to argue from a water culture to a soil. It is, however, a distinct step in advance that an acid has been isolated from certain soils and identified, and shown to be poisonous in water culture. The results may well be connected with the known fact that, in absence of lime, soil becomes acid and loses fertility, which can only be restored by addition of lime or chalk.

[1] Bulletin 70, Bureau of Soils, U.S. Department of Agriculture.

So great is the part played by bacteria in determining fertility, that a great amount of attention is being paid in most soil laboratories to their various actions. The fixation of nitrogen is of perennial fascination, and is still far from being solved. Certain bacteria, notably azotobacter, can take up gaseous nitrogen and synthesise protein, nuclein, &c., without any materials save only sugar and various mineral salts. The organisms occur in most soils, and it is only necessary to inoculate small quantities of soil into a solution containing the sugar, phosphates, potassium and other salts, but no nitrogen compounds, for development to take place and nitrogen fixation to occur. The chemistry of the process is unknown; investigation, so far, has been confined almost entirely to morphological work and to the effect of various conditions on the process. Messrs. C. Hoffmann and B. W. Hammer, of the University of Wisconsin Agricultural Experiment Station, have recently (Research Bulletin 12) repeated and extended some of these observations. They find the best sugars are mannite and lactose, but it is not desirable to have too much. Similarly, there is no advantage in having too much calcium carbonate, although some is needed. In one respect these authors differ from previous investigators; on analysing the dry azotobacter cells they obtained a protein content of 17·75 per cent. only, against 80 per cent. found by Gerlach and Vogel and 70·6 per cent. by Stoklasa. The cause of the difference is not clear, but may perhaps be ascribed to the slime that invariably surrounds the organism without being an integral part of it, and that is only removed with great difficulty.

How far azotobacter is active in the soil is difficult to determine, because there is an opposite process, the liberation of gaseous nitrogen from protein, and also, under anaerobic conditions, from nitrates, also brought about by bacteria. But it has been shown by Koch that the addition of sugar to soil some months before the seed was sown led to an increase in crop by increasing nitrogen fixation, although if applied direct to the crop it produced harmful results. These facts are attracting much attention in sugar-producing countries, and it has been shown that waste molasses, which cannot profitably be sold, gives useful increases in crop when applied as manure some weeks before planting, especially on light soils. S. S. Peck, of the Hawaiian Sugar Planters' Experiment Station (Bulletin 34), has studied the two changes, nitrogen fixation and denitrification, and confirms the general results already obtained; molasses applied before planting stimulates nitrogen fixation, but applied to the growing plant it does harm by causing loss of nitrate or diminished nitrification.

He also confirms some recent work of Russell and Hutchinson, and finds that numbers of protozoa harmful to bacteria occur in soil—he found amœbæ, paramecium, and others—all of which can be destroyed by moderate heat or antiseptics like carbon disulphide. Partial sterilisation of the soil is being studied in several directions. *The Journal of Agriculture of South Australia* states that farmers there have long recognised the advantage of burning the stubbles, and thus heating the soil; investigations are in hand at the Roseworthy Agricultural College to study the problem from this new point of view. An apparatus for soil sterilisation suitable for gardeners is described in *The Journal of the Department of Agriculture of Victoria*, which is similar in principle to some that are working in England. *The Scientific American* recently gave an account of methods proposed in the United States.

Although nitrates are invaluable in the soil, an excess is injurious, because it causes plasmolysis. Dr. Headden, of the Colorado Agricultural College Experiment Station (Bulletins 155 and 160), reports analyses of soils in Colorado containing such excessive amounts of nitrates that they were sterile. He thinks their formation can be explained only as due to bacteria; he supposed that nitrogen fixation has gone on to an excessive degree, and has thus led to disastrous consequences. Further work on these soils will be awaited with interest.

The factors determining soil fertility are slowly being disentangled, but they are far from being fully known, and therefore investigations of cases of infertility are of considerable scientific interest, besides being of technical importance. Such a case is afforded by the scouring pastures of Somerset, now being studied by C. T. Gimingham, of the University of Bristol. Pastures in certain districts of the Lower Lias formation cause diarrhœa or "scouring" in cattle fed on them. No obvious explanation is forthcoming, no poisonous weeds are found, nor does the provision of a pure water supply obviate the trouble. Mr. Gimingham has, in *The Journal of the Board of Agriculture* (No. 7), collected the main facts, and adduces strong evidence to show that the physical condition of the soil is the determining factor, the peculiar conditions obtaining on the Lower Lias, but not on the adjacent alluvium and Inferior Oolite, being favourable to the factor actually causing the disease. Experimental work on this subject is necessarily slow and tedious, but, in view of its importance, it is much to be hoped that Mr. Gimingham will be able to continue the work on the sound lines on which he has begun.

The phenomena of flocculation and deflocculation in soils have been much investigated, but are far from being worked out. E. E. Free has recently summarised (Journal of the Franklin Institute) the present position of our knowledge, and has shown that a marked influence is exercised by impurities present in the water in which the suspensions are made for experimental purposes. He considers it probable that in absolutely pure water only a medium degree of permanence would be attained. In his view, any material can be suspended in water, flocculated, and deflocculated, if it can be got in a sufficiently fine state.

E. J. RUSSELL.

MUSEUM WORK IN INDIA AND AFRICA.

ACCORDING to the report of the Natural History Section, the year 1909–10 was an important one in the development of the Indian Museum, Calcutta, as it witnessed not only a reorganisation of the staff of that section, but likewise the passing of an Act to give greater independence to the constituent sections in the matter of scientific and educational work, and also to permit the respective chiefs of the same to become *ex officio* members of the board of trustees. As a result of the new regulations, it will be possible to separate the archæological from the zoological section, and to place the former under the control of the director of the Archæological Survey. Among the additions during the year, attention is directed to the cast of a susu, or river-dolphin, from the Hughli.

The report on the fishes collected by the *Golden Crown* is continued, by Messrs. Annandale and Jenkins, in No. 1 of the third volume of the Memoirs of the Indian Museum, these contributions including a supplementary note on the rays, together with accounts of the Plectognathi, Pediculati, and flat-fishes. As the collection of sharks made by the *Golden Crown* was relatively small, the consideration of that group is postponed. The teleostean collection, on the other hand, is so extensive that its description in an adequate manner will practically mean a revolution in our ideas of the Indian marine fish-fauna. In the present contribution three small and compact groups, to which the additions are comparatively few, have been selected for treatment.

From among nine papers on various groups of invertebrates in the fourth part of vol. v. of the Records of the Indian Museum it must suffice to refer to some interesting information, by Messrs. Henderson and Mathai, on the occurrence of dimorphism in certain fresh-water prawns of the genus Palæmon. In many, if not all, the species two forms of adult males occur, namely, a normal type of relatively large size, with well-developed nipping-claws, and a generally smaller type, with the same claws no bigger than in females. Among certain other decapods in which a similar dimorphism obtains, the two phases are recurrent, and severally represent the breeding and non-breeding conditions; but, so far as the authors of the paper could ascertain, this does not appear to be the case with the Indian Palæmons.

The classification of the anopheline mosquitoes of India forms the subject of No. 5 (it may be noted that "part" and "No." are respectively used in the two issues) of vol. iv. of the serial last quoted. The changes proposed are of a radical character, the author, Major S. P. James, refusing to admit that any of the species are referable to the typical Anopheles. The Indian members of the group

are divisible into two series, respectively characterised by the presence or absence of scales on the abdomen.

To the Annals—which now bear the alternative title of Mededeelingen—of the Transvaal Museum for November, 1910, Mr. J. Hewitt contributes a key to the South African members of four families of lizards, with notes on their distribution. The issue is also noteworthy on account of the inclusion of eight beautifully coloured plates to illustrate Mr. Meyrick's article on Microlepidoptera published in an earlier part.

REPORT OF THE BOARD OF EDUCATION.

THE report of the Board of Education for the year 1909–10, published a few days ago (Cd. 5616, price 8*d.*), contains an instructive statement of the position of elementary, secondary, and technical education in England. One section of the report, dealing with the teaching of science in secondary schools, was reprinted in NATURE of May 4 (p. 326), and we now give an abstract of other portions. The section of the report devoted to elementary education reviews the history and recent development of the provision made for teaching the pupils in public elementary schools, and touches upon certain aspects of the subject of school staffing which have been especially prominent very recently. With this subject we are not particularly concerned in these columns, but the subjoined extracts, relating chiefly to higher education, will interest readers of NATURE.

Establishment of the Universities Branch of the Board.

The Board has recently organised a special branch of its department to deal with the many matters arising from the connection with the work done by the modern universities. Experience had shown that the technological and professional instruction (including the training of teachers for elementary and for secondary schools) given by the universities and aided by grants from the Board, could not be properly dealt with as part of the ordinary administration of the Board as applied to institutions which have less autonomy, responsibility, and prestige than the universities. The universities need the greatest possible degree of freedom in organising and carrying out their important national and international functions, and the Board has for long been convinced that their relations with the universities should be so adjusted as to further this end. In April, 1910, the President accordingly appointed the Board's director of special inquiries and reports, Mr. H. F. Heath, to the office of principal assistant secretary for the new universities branch of the Board. Mr. Heath had a long connection with, and an intimate knowledge of, the modern universities before his appointment to the Board in 1903, and his work in the Board's staff as an advisory rather than an administrative officer since that date marked him out as specially qualified for the new post. Mr. Heath continues to hold his office as director of special inquiries and reports.

The International Commission on the Teaching of Mathematics.

In view of the fact that a meeting of the International Congress of Mathematicians is to be held at Cambridge in 1912, and that an International Commission on the Teaching of Mathematics has been constituted in connection with the educational section of the congress, the office of special inquiries and reports has made arrangements to publish a series of papers dealing with the teaching of mathematics. It is intended that copies of these papers shall be placed at the disposal of the International Commission, and that they shall ultimately form a volume or volumes in the series of special reports on educational subjects.

An advisory committee has further been appointed by the President of the Board to assist in the collection of papers and to advise as to the suitability of the contributions sent in. This committee will also act as the British Subcommission—one of a number of national subcommissions established to assist the International Commission in its work—and is constituted as follows:—Mr. C. E. Ashford, Sir G. H. Darwin, K.C.B., F.R.S., Prof. G. A. Gibson, Mr. C. Godfrey, Sir George Greenhill, F.R.S., Mr. G. H. Hardy, F.R.S., Prof. E. W. Hobson, F.R.S., Mr. C. S. Jackson, Sir Joseph Larmor, M.P., F.R.S., Prof. A. E. H. Love, F.R.S.

Mr. C. S. Jackson is honorary secretary to the British Subcommission.

The Science Museum.

The needs of the Science Museum have been before the Board for some years, and it has recently become possible to take active steps to provide for them. The matter formed the subject of a memorial of great weight, presented just a year ago by a deputation representing the learned societies, the universities, and the technical colleges of the country; and the evidence then put before the Board amply confirmed the view that the science collections are even now of great value to the nation, but that their usefulness is crippled, and their growth prevented, by the inadequacy of the buildings in which they are housed.

The accommodation for these rich collections, which include many inventions that have proved to be pioneers in industrial arts and afford much effective exposition of modern developments of pure and applied science, ought to be in every way worthy of the interests which they serve. What has now to be done to meet this requirement ought to be done on a scale and in a form that will give the Science Museum an assured place among the permanent national institutions of the country. The Board is anxious that the scheme for the future development of this museum should receive adequate consideration before the work is actually put in hand, and it feels that the requirements of the collections in the Museum of Practical Geology in Jermyn Street should be discussed at the same time. In whatever action it may take in this matter, it wishes to assign to the valuable collections in these two museums definite part in the provision of facilities by national museums. A Departmental Committee was therefore appointed in March, 1910, to consider and report upon various questions in regard to the collections. In particular the committee was asked "to advise (*a*) as to the precise educational and other purposes which the collections can best serve in the national interests; (*b*) as to the lines on which the collections should be arranged and developed, and possibly modified, so as more effectively to fulfil these purposes; and (*c*) as to the special characteristics which should be possessed by the new buildings, which it is hoped will shortly be erected on the South Kensington site to house these collections, so as to enable the latter to be classified and exhibited in the manner most fitted to accomplish the purposes they are intended to fulfil." [See NATURE, May 4.]

The committee informed the Board in a preliminary report in July last as to the general conclusions it had then reached on these questions, and in particular as to the nature and extent of the collections and as to the size of the buildings that would be required for such a development of the collections as they contemplated. The Royal Commission for the Exhibition of 1851 has intimated that it is prepared to make a grant of 100,000*l.* from the funds at its disposal towards the erection of a new building for the museum, the balance of the cost of which would be provided from public funds.

Secondary Schools (England).

The total number of schools regarded as eligible for grant during 1909–10 was 841, as compared with 804 during 1908–9. Of these, 325 were controlled by local authorities, 447 were endowed schools or schools of a similar type, 29 were schools belonging to the Girls' Public Day School Trust, and 40 were controlled by Roman Catholic teaching orders. In these schools there were on January 31, 1910, 76,909 boys and 64,649 girls, as compared with 73,273 boys and 62,401 girls on January 31, 1909.

In addition to the 841 schools on the grant list there were 87 other schools recognised by the Board as efficient during 1909–10, being an increase of 5 on the number recognised as efficient during 1908–9. Of these 67 were endowed schools or schools of a similar type, 3 were controlled by Roman Catholic teaching orders, and 17 were private schools. In these schools there were on January 31, 1910, 8215 boys and 7249 girls, as compared with 7117 boys and 7179 girls on October 1, 1908.

Thus during the year 1909–10 there were in England altogether 928 schools recognised by the Board as efficient, educating 85,124 boys and 71,898 girls, as compared with

886 schools in 1908–9 educating 80,390 boys and 69,580 girls.

Length of School Life.

The length of school life is a matter to which the Board attaches very great importance, for if the bulk of the pupils in fact drop out of a secondary school after passing through only a fraction of the school course, it is clear that the secondary school is not fulfilling its aim and is not entitled to State aid. An article of the regulations expressly provides that a school will not be recognised as a secondary school unless (1) an adequate proportion of the pupils remain at least four years in it, and (2) an adequate proportion of the pupils remain in it up to and beyond the age of sixteen.

The average length of school life in schools on the grant list is not yet nearly so high as it should be. Some improvement is being made, but it continues to be slow.

At the end of 1909 the Board took up the cases of thirty-five schools which appeared to have an exceptionally short average school life, and, after a careful investigation of the circumstances of each case, addressed to twenty-six of these schools a warning that continued failure to comply effectively with the Board's requirements would entail removal from the grant list. In many of these cases the Board suggested that an undertaking should be required from the parents of all pupils, on their admission to the school, that they would not be removed without good reason before completing an adequate period of school life; and directed attention to the fact that such an undertaking with a penalty enacted had already been adopted by several school authorities with marked results. The suggestion has, as a rule, been cordially accepted, and is, it is believed, already having good effect; but these and all other cases where there is a tendency for the school life to be abnormally short are being kept under careful observation, and action is being taken where necessary.

Attendance at Evening and similar Schools.

Statistics for 1909–10 with reference to schools and classes intended for those whose ordinary avocation occupies the greater part of their time will be given in the statistical volume for that year, to be issued later in 1911. Reference, however, to Tables 83 and 99 in the 1908–9 statistical volume reveals an increase in the total number of students enrolled in these schools from 751,600 in 1907–8 to 752,356 in 1908–9. These figures show but little progress in popular appreciation of the facilities offered to those desirous of recovering what they have lost of their previous education, or wishing to obtain a wider and firmer grasp of the principles underlying their several callings, whether these be in industries, in commerce, in professions, or in domestic occupations. It is also matter for regret that nearly 20 per cent. of the students enrolled failed to complete the small minimum of attendances required in order to enable grants to be paid towards their instruction.

The average number of hours of instruction received per student in the county boroughs (including London) as a whole was 55. In seven county boroughs this average was under 40; and in 21 others, while more than 40, it was under 50. In 47 it was above 50; in nearly all of these it was under 80, but in 10 county boroughs, situated in Lancashire and Yorkshire, and in one in Cheshire, the average number of hours received per student during the year 1908–9 exceeded 80, in two cases the average being more than 100 hours. In such cases the high average reflects considerable credit on the organisation of the work of further education, and very satisfactory results may fairly be anticipated from the instruction received by the students.

In the administrative counties (excluding London) each student received on an average 48 hours of instruction. In view of the number of short courses of special instruction recognised as eligible for grants in certain rural areas, as well as for other reasons, it is to be expected that the average should be lower in rural than in urban areas. Only in seven cases, however, was the average below 30 hours; in 17 others, while more than 30, it was under 40; in the remaining 37 this average was above 40, and in three of these cases it exceeded 60, in two of them being more than 80.

From these figures it will be seen, on one hand, how meagre is the amount of instruction received by the students in some areas, and, on the other, that even under existing circumstances some students can be induced to give real and continued attention to their further education.

The number of students more than 21 years of age has fallen from 253,677 in 1907–8 to 247,436 in 1908–9.

Technical Institutions.

The total amount of advanced instruction of the kind provided in technical institutions is still disappointingly small. In some of the more important industries, as, for example, engineering, the instruction is largely utilised by students; but in a great many others the supply of students is very small. It is to be deplored that there are several schools in which the well-qualified staffs and the excellent equipment practically stand idle in the day-time through lack of students.

The students enrolled in the 42 technical institutions which were recognised as eligible for grant in 1908–9 numbered 3400, of whom 3010 qualified for grant. Of these latter 1990 took full courses of instruction; 806 were engaged in the work of the first year, 653 in that of the second, 406 in that of the third, and 125 in still more advanced work. There is still a tendency to admit students to technical institutions before they have had an adequate course of general education; 211 students were under 16 years of age at the opening of the session 1908–9.

For the year 1909–10, 49 technical institutions were recognised as eligible for grant, showing an increase of seven over those recognised in the previous year.

Day Technical Classes.

Grants are payable under Article 42 of the regulations to schools and classes which are, as a rule, for students younger than those in the technical institutions. Under this category there are included, however, some classes of a standard equal to that required in a technical institution, but with courses not of sufficient duration to be eligible for grants as technical institutions. Day technical classes vary in their aims, some being preparatory to trades, such as engineering, others providing instruction of a domestic type, others again being for blind or deaf students.

In 1908–9, in England and Wales, day technical classes were recognised as eligible for grant in 103 institutions; and at the 180 courses for which grants were paid, 10,237 students were enrolled, of whom 9636 qualified for grant. Of these courses, 109 were full-time and 71 part-time; 6137 students attending the former, 3499 the latter. Of the full-time courses, 52 were for junior students, of whom 4039 qualified for grant, and 57 courses were for senior students, of whom there were 2102 who also satisfied the conditions of eligibility for grant.

For the year 1909–10, day technical classes were recognised as eligible for grant in 109 institutions.

THE BRITISH SCIENCE GUILD.

THE report of the British Science Guild, presented at the fifth annual meeting, held on April 7, has just been distributed. A few of the subjects dealt with in the report were mentioned in the account of the annual meeting which appeared in NATURE of April 13; and we now reprint the section referring to Government organisation, a summary of the first report of the Canadian committee, and the conclusions and recommendations of the Technical Education Committee. The report of the Canadian committee shows that valuable work in promoting the aims of the Guild is being carried on in the Dominion. We note with interest that among the subjects receiving consideration are the teaching of science in schools, technical education, the conservation of natural resources, and the location of icebergs by their temperature effects—a very important matter to ships navigating in many waters during foggy weather.

The report of the Technical Education Committee, which runs to forty-eight pages, should be read in connection with Lord Haldane's remarks upon technical education at the annual meeting. In the course of his speech, he said:—"With regard to technical education, there is more going on in this country than people realise, and the mistake that has led to the want of recognition of this is the habit people

have of comparing things that are unlike. It is quite true that in higher education and in the application of science to industry Germany has marked features which we do not possess, but evening schools and evening classes connected with universities or technical colleges are things which are little known in Germany as we know them."

Lord Haldane seems himself to have erred in comparing things which are unlike, and the conclusion derived from the comparison is, therefore, misleading. Our evening-class system is admirable, but as the report of the Guild's Technical Education Committee points out, it is to a large extent of the nature of continuation school work, and has no relation to technical education rightly so-called. About three-quarters of a million students attend evening schools and classes, but the average number of hours of instruction received by each student throughout the session is only about fifty, and 20 per cent. of the students fail to complete the small minimum number of attendances required by the Board of Education as qualification for a grant toward the instruction. Moreover, nearly 150,000 students in evening schools and classes are under fifteen years of age. It is obvious that, however excellent this evening-school work may be considered from the point of view of further education, it can be of little assistance to national industries and manufactures which require highly specialised knowledge and research for their development.

The latest report of the Board of Education provides the best reply to the suggestion that we have reason to be satisfied with what is being done for technical education in England. It appears from this report that in the forty-two technical institutions recognised by the Board (and that number includes practically all the technical schools and colleges in which organised courses of relatively advanced instruction are given in the day-time, as well as applied sciences departments of such Universities as Birmingham, Liverpool, Manchester, and Leeds), about 2000 students took full courses of instruction in 1909–10. Of these students only about 400 were engaged in work of the third year, and 125 in still more advanced work. What it comes to, therefore, is that the total number of day students in English polytechnics, technical schools, and colleges is less than in a single German technical university such as that of Charlottenburg or Munich.

But putting comparisons aside, there is surely nothing to be satisfied with in the fact that only 125 students in the technical institutions connected with the Board of Education are doing work beyond that of the third year, considering that the entrance age is sixteen, and in some cases is reduced to fifteen years. No wonder the Board of Education remarks in its report:—"It is to be deplored that there are several schools in which the well-qualified staffs and the excellent equipment practically stand idle in the day-time through lack of students." Details of our position as regards technical education, and suggestions for its improvement, will be found in the report of the Technical Education Committee, printed as an appendix to the report of the Guild. The subjoined extracts from the general report and this appendix are of particular interest.

Government Organisation.

In the appendix to the fourth report several opinions were quoted touching on the need of a better reorganisation of our executive Government. It was pointed out by our president that at present our "executive government is about as disorganised and chaotic an institution as anybody can conceive." "There was too little science in it at the present time. There was hardly a department which did not require the aid of science if it was to be effective."

"I believe that things will not be right until we have a scientific corps under a permanent committee, just as the Defence Committee is under the Prime Minister to-day. I think you should not have a body which consists of officials of the ordinary kind, but one which should consist of the most scientific men, who would go there because they are honoured and paid, and put on the footing on which they deserve to be placed, and are recognised as a body of men who will be at the elbow of the department, and who can organise the scientific work of the State. If we get that, as I hope we shall, I trust that the example of the Government in adopting science will be followed by the municipalities, as I believe it is going to be followed more and more by our manufacturers."

"The creation of the Committee of Imperial Defence carried scientific principles into the sphere of government, and was the first step towards getting military and naval motions into order. We now have a general staff which is a body, not to exercise command, but to give advice in a thoroughly practical fashion and in a fashion which can be enforced. The speculation may be indulged in whether one of the great reforms of government to which we are coming—because we have been driven to it—will not be the creation in an organised fashion of just such a general staff for departments of government, and not merely for the army."

Apart from the question of advisory committees already referred to, there are other parts of our administrative system, or want of system, which have to be considered.

The oldest Government departments were set going in the pre-scientific age. War, diplomacy, and finance were then the chief things considered. The State did not concern itself with commerce and industry, or the health or education of the people, nor had science or art any place in the administration. It was in connection with the Navy that the first scientific services were established, the Royal Observatory for preparing an ephemeris[1] and a survey of the seas to render the navigation of warships more secure.

In most Continental nations, including our own, the scientific education of army and navy officers was insisted upon long before that of civilians; hence the former were necessarily employed in various departments of the State, when the necessity of facing scientific problems arose. Thus our land survey was carried out by the Board of Ordnance.

It was while this state of things existed that the Board of Trade and the Department of Science and Art were established, as a result of the Prince Consort's warnings and pleadings. It was the Board of Ordnance which supplied its well-instructed officers of engineers to these and other public departments as the need for scientific treatment arose, and because fully educated civilians were not available either in the departments or outside them. It is in consequence of these various additions to the State machinery at different times to meet different needs that the "chaotic" condition to which our president has referred has arisen. The new problem raised by the necessity of scientific inquiries to aid the service of the State has not yet been faced.

To take an instance of our administrative system, or want of system, we may refer to our national surveys. Our four national systems of surveys of the surface of the land, of which that surface consists and of what lies underneath it, of the air and of the seas, are at present controlled by four different departments of the State.

The two land surveys, one using the maps prepared by the other, are controlled, one by the Board of Agriculture, the other by the Board of Education. The Meteorological Office, which deals with the air, is under the Treasury, while the hydrographic survey is controlled by the Admiralty.

There is good reason for the last named being under the Admiralty, because to the Admiralty belong the ships which are necessarily used in the work; but there is no reason why the other three surveys should not be administered by one department.

The question arises whether the surveys dealing with the land surface and what lies beneath it should not be brought together, and under the Board of Education, and whether the air survey (the Meteorological Office) should not be transferred from the Treasury to the same department, which already administers the Solar Physics Observatory, in which allied work is carried on. The recent transfer to South Kensington of the Meteorological Office is another argument in favour of this proposal.

To take another instance. The primary, secondary, and technical education of the country is controlled by the Board of Education, while the Treasury is supreme in matters relating to the universities. The situation is as if

[1] Even then, however, according to Sir George Airy, the latitude of the court had more to do with the foundation of the Observatory than the importance of determining the longitude at sea A Royal mistress had reasons for wishing the new departure.

the Secretary of State for War were only concerned with barrack-yard drill, the higher training at Aldershot and Salisbury Plain being in charge of another Minister.

No other civilised Government attempts to deal with general education in two watertight compartments. The present position suggests inquiry which may show that the Board should really be made responsible for the whole of the educational ladder, and not merely for the lower rungs of it. This would take from the Treasury a matter with which, from its constitution and personnel, it is not so fitted to deal as is the Board of Education.

We have already found in two cases, the Meteorological Office is one and university education another, and to these can be added a third, the administration of scientific grants, in which the Treasury, the function of which is to control the expenditure of spending departments, acts as a spending department itself; an Alice in Wonderland arrangement, in which the Chancellor of the Exchequer acts both as judge and jury; there is no Minister in the Cabinet to advise or defend expenditure thus administered, except the one whose chief function is to veto it, and no consultative committee to refer to; to this may doubtless be attributed the small regard paid to the claims on behalf of science and the higher learning generally.

In the matters under review the practice of foreign Governments varies according as science is regarded from the pure or applied standpoint, but the rule most generally acted on is to place the scientific services under the control of the Minister of Public Instruction, who is thus a Minister for Science.

It would appear from the foregoing references to the distribution of the services among departments, that much of the apparent confusion would disappear if certain of them were transferred to the Board of Education. This would be in harmony with Continental practice, and would have the advantage of utilising to the fullest extent the services of an advisory committee, when, following the precedent recently so fully acted on, one is appointed to deal with the scientific services. Another way out of the present chaos is to appoint a Minister of Science.

Although the words "Science and Art" have disappeared from the title of the Board of Education, it still carries on the work of the Science and Art Department, and the more thoroughly it is carried on and developed the better it will be for the nation. It is unfortunate from this point of view that in the controversies which have been carried on of late years in the name of education, the real functions of the Board have become obscured.

If we pass to the question of museums we find the same chaos; this was reported on by the Duke of Devonshire's Commission in 1874. Of these the oldest, the British Museum, including the Natural History Museum with a Geological Department at South Kensington, is administered by trustees; the youngest, the Victoria and Albert Museum and the Science Museum, also at South Kensington, by the Board of Education.

The Board of Education also controls the Geological Museum at Jermyn Street, the Geological Department of the British Museum being, as stated above, at South Kensington.

The above anomalies lie on the fringe of the subject; they are given as examples of the ground to be covered when an inquiry is made.

Conclusions and Recommendations of the Technical Education Committee.

(1) The work of technical education should be organised as a national system. A system of scholarships or bursaries should enable the most promising students to pass from the technical school to the university, or to highly specialised institutions established to promote the scientific and practical study of particular industries. Technical institutions of sufficient standing should be connected with local universities, and others should be assigned work and place in an organic scheme to prevent waste of effort and undesirable competition.

(2) There should be a national Advisory Board for Technical Education and local Advisory Boards should also be appointed; these should include a certain number of teachers as well as representatives of industry and commerce. Greater appreciation of the value of scientific and technical education to industrial progress may thus be secured. The development of specialised institutions closely connected with local industries is always promoted by the appointment of representatives of the leading manufacturers upon the governing bodies of such institutions.

(3) Courses of study and syllabuses leading to national certificates in technical education should be approved by the National Advisory Board. Such work should be of a more advanced character than that for which local bodies may grant certificates, but a national certificate relating to attainment in the specialised knowledge of the district could be established by the local and national Advisory Boards acting jointly.

(4) Evening classes provide a valuable means of combining theoretical studies with actual practice—concurrent training in factory and school—and have done much to qualify strong and capable men for positions of responsibility in commerce and in certain industries. An extension of the opportunities for part-time study in the day is, however, greatly to be desired, and the increase of such classes should do much to advance technical education.

(5) There should be in each district a sufficient number of (*a*) trade preparatory schools for pupils of about twelve to fifteen years of age, such schools to differ from ordinary secondary schools in the large amount of time given to various forms of manual instruction; (*b*) continuation schools for part-time day pupils and for evening pupils. Both (*a*) and (*b*) would be concerned chiefly with the further education of pupils trained in primary schools.

(6) For the comprehensive training required to produce future captains and leaders of industry, whole-time instruction is essential in institutions of advanced type. It is desirable that each institution of this type should add to its curriculum, as far as possible, specialised instruction in a particular subject, or group of subjects, relating to one or more of the principal industries of the district.

(7) The national and municipal expenditure upon education in England in respect of technical, art, evening, and similar schools and classes is about one and a half million pounds per annum: and the number of students above fifteen years is about half a million; so that, neglecting younger pupils, the annual cost is only about 3*l.* per student. As, however, the chief part of the work of most of the schools, whether day or evening, is elementary or of a continuation-school grade, it cannot be classified as technical education; hence the actual expenditure upon technical education properly so called is only a small amount of the total.

(8) In most parts of the country, bursaries or scholarships are provided, by means of which promising pupils in public elementary schools may pass into secondary schools or technical schools, and thence into a technical college or university for more advanced instruction. For work of what may be called a post-graduate standard, however, little provision has been made, though it is of the highest importance. To secure the highest development of industries, highly technical and specialised work must be carried on in suitable institutions by well-qualified students. Increased facilities should therefore be afforded by liberal scholarships or other assistance, to enable such students to enter institutions of this type and maintain themselves while following approved courses of study or research.

Report of the Canadian Committee.

Since the meeting of the organising committee of the British Science Guild in Canada, held in Winnipeg during the meeting of the British Association, the Canadian committee has been established on a firm basis, and some definite work has been undertaken. It is a source of satisfaction to have the sympathy and advice of Lord Strathcona, who kindly consented to become honorary president of the committee this year, owing to the withdrawal of Earl Grey as Governor-General of Canada.

One of the most important questions now being considered by this committee is the teaching of science in the schools. A special subcommittee has been formed, with Dr. C. J. Lynde, Department of Physics at Macdonald College, as chairman. The object of this committee is to gather information as to the facilities for science teaching offered in the various provinces. The committee has in view the following questions:—

What sciences are taught in the schools, and by whom? What qualifications (academic or professional) has the teacher?

Is the instruction assisted by lecture, experiment, and laboratory work?

How far instruction in physics or chemistry encourages scholars to take up a scientific or technical career?

In what way can assistance be given by the universities to the science teachers in the schools?

Whether the giving of one or two lectures by university professors in the schools from time to time, on modern development in science, would be of assistance to the teachers?

Whether special summer courses in elementary science given in the universities would be of help to the science teachers?

Whether there is a modern scientific publication taken regularly by the school, or by the teacher?

Dr. J. W. Robertson, a vice-president of the committee, has been appointed by the Government chairman of the Commission on Technical Education. This commission is entrusted with the duty of thoroughly investigating the needs for technical training all over Canada. It will, in addition, go to the United States and Europe, where the educational systems will be thoroughly investigated. In Dr. Robertson's own words, we state the work of the commission. He said that "the Government had expressed a recognition in a new form of the heritage of Canadians. This recognition is in the form of the conservation of the resources of the country. These cannot be utilised until the people have been educated in this regard, and in their proper development. The best way is that whereby labour can be applied with the least waste, cost, &c. Industrial efficiency is an all-important item in the successful development of Canada. The commission, by investigation and by personal observation, is to secure all the information possible on the industrial life of Canada."

One of the vice-presidents of this committee, Mr. F. H. Sexton, is director of technical education for Nova Scotia. Prof. Sexton's work is proving of the greatest benefit to the province. It is to be hoped that his efforts may be directed to wider fields. Nova Scotia was the pioneer in establishing technical education in America, being the first province in the Dominion to do so, and being two years ahead of Massachusetts, which was the first State of the Union to take this up. Through Prof. Sexton's efforts, there exists in all the colleges a uniform course of study for the first two years' work. Scholars can then do advanced work in the provincial technical college in any branch of engineering they desire. There are a number of night schools, mostly for miners, which are of great benefit. These schools are supported by the Government, and are entirely free. They are not intended to increase the number of men seeking employment, but to increase the efficiency of those already at work.

A commission has been appointed by the Government to study the natural resources of the country. In this important matter the Guild committee is ably represented by the Hon. Sydney Fisher, Minister of Agriculture, one of our vice-presidents.

The Forestry Association in Canada has been actively engaged in educating the people to a better appreciation of the value of conservation. There exists in Canada at the present time vast areas of forest wealth. Each province has its own forestry regulations, and much valuable material has been collected and distributed by the association. It is safe to predict that the paper-making industry will in the near future be controlled in Canada. The destruction by fire is one of the most serious features of our national loss. Through the efforts of the association, however, greater intelligence is being displayed in fire patrol. The people are beginning to realise the need for stricter regulations in the forest regions.

In the matter of parks and playgrounds in the rapidly increasing City of Montreal, one of the members of the committee, Dr. J. G. Adami, F.R.S., has been among the chief workers in securing a Parks Commission, which is to have power to acquire land for parks in and around the city, as well as to investigate the housing of the poor. Dr. Adami has been active, also, in the work for the prevention of tuberculosis, and much good has already resulted from his labours.

The secretary has been devoting much study to the ice conditions of the St. Lawrence River as it affects navigation. A report now being printed by the Department of Marine and Fisheries sets forth the result of the study last year. The Minister of Marine, the Hon. L. P. Brodeur, one of the vice-presidents of the committee, has shown the greatest interest in this work, and has given the secretary every facility for study. Investigations have been carried to the lower St. Lawrence and Gulf in order to determine a matter of vital importance to the St. Lawrence route to be able to determine the influence of icebergs on the temperature of the water. It is a matter of vital importance to our St. Lawrence route to be able to determine the effect of icebergs, and, if possible, devise some means for ships to locate them when navigating in foggy weather. Already an instrument has been devised which is capable of detecting the temperature effect of an iceberg for distances varying from two to seven miles. This year the Minister has so far recognised the importance of the work by detailing a special ship for the temperature tests.

It is hoped that the Canadian committee may be of active help to the British Science Guild by advising it on Canadian questions. Already the Canadian committee has received assistance from the secretary in London on the question of the work of the National Standards Laboratories, for which it desires to express its thanks.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. G. E. Moore has been appointed university lecturer in moral science for five years from October 1, 1911, until September 30, 1916.

Mr. Keith Lucas has been approved by the general board of studies for the degree of Doctor in Science.

On Thursday, May 11, the following Grace will be offered to the Senate:—That the bequest to the University by the late William Chawner, Master of Emmanuel College, be gratefully accepted, and that the Vice-Chancellor be requested to communicate this Grace to Mr. Chawner's executors.

OXFORD.—Further instalments of the scheme of university reform are promised for the present term. On May 16 the preamble of a statute exempting honour students in mathematics or natural science from the requirement of Greek in Responsions will be submitted to Congregation, and on May 23 the first stage will be taken of a statute constituting a new board of finance, the main duties of which will be to review annually the published accounts of the University and colleges, to report thereon to the Hebdomadal Council, and to advise the council generally on matters of financial administration. It is not proposed to abolish the existing board of curators of the University chest, but to continue it, with somewhat limited powers, side by side with the new board of finance.

A member of Congregation has circulated a protest against the proposed exemption of science and mathematical students from compulsory Greek. His main points against the measure are that it will tend to diminish the opportunities given in the smaller grammar schools and new "secondary" schools for the teaching of Greek to boys of pronounced literary gifts, and that it will lead to an undue diversion of endowments in the University and colleges from the literary and historical and philosophical humanities, which he thinks are in some danger of being neglected in other universities and in the country at large, whereas science is in no such danger.

Statutes reconstituting the boards of electors to fourteen mathematical and science professorships in the University passed Congregation on May 9 without opposition.

BIRMINGHAM.—The University is the recipient of a munificent bequest under the will of Mr. John Spencer, of Handsworth, chairman of Messrs. John Spencer, Ltd., tube manufacturers, of Wednesbury. The bequest includes "5000*l*. to the University of Birmingham, to be applied in the advancement of science and in promoting the work-

ing out of scientific problems in any department of science in such a way as the principal and vice-principal shall determine as being wisest and best for the end I have in view, which is to promote discovery and knowledge, believing that this conduces to the good of humanity." In addition to this, the University will ultimately, as residuary legatee, receive the benefit of considerably more than the above amount.

DR. A. E. KENNELLY, of Harvard University, has accepted an invitation of the University of London to come to London for the purpose of delivering a course of advanced lectures, and has chosen as his subject "The Application of Hyperbolic Functions to Electrical Engineering Problems." The course will be given at the Institution of Electrical Engineers at 5.30 on five consecutive days, commencing on Monday, May 29, and tickets of admission may be obtained free by application to the academic registrar of the University of London.

THE leading article in *The Builder* for May 5 deals with the amalgamation of the Society of Architects with the Royal Institute of British Architects. It is a matter of congratulation that a mutually satisfactory basis of amalgamation has been arranged. The unity of action which will result in matters connected with registration and with education cannot fail to be of benefit to the profession. There must be many whose chief interest in obtaining a settlement of the question of registration is based on the hope that it will clear the ground for a thorough reorganisation of our educational methods, without which our architecture must drop behind that of other nations. If the new union will secure this advance, it will justify all the sacrifices that have been made to consummate it.

THE Worshipful Company of Drapers has given to the Battersea Polytechnic the sum of 6000*l.* in order to erect a building to house a department which is to include such branches of science as physiology, hygiene, bacteriology, and also that further work which, for want of a better name, may be termed hygiene or town planning. It is hoped also to include the subject of geology, more particularly in its application to the nature of soils, forms of vegetation, &c. It is expected that important results will arise from the establishment of this new work, and that the department is likely to prove, from the sanitary science point of view, of great service, inasmuch as it will give opportunities for the study and advancement of the principles which in the future must control life, and especially that of the towns. A suitable letter of thanks has been sent to the Drapers' Company for their munificence.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society May 4.—Sir Archibald Geikie, K.C.B. president, in the chair.—Dr. F. W. **Mott,** Edgar **Schuster,** and Prof. C. S. **Sherrington**: Motor localisation in the brain of the Gibbon, correlated with a histological examination. A comparative study of the convolutional pattern of the brains of lemurs and apes led to the expectation that the remarkable use the Gibbon makes of its arms and hands would be found by experiment and histological investigation to be correlated with the remarkable expansion of the cortex cerebri in the precentral region as shown by the development of a broad gyrus extending from the middle of the precentral region to form the second frontal convolution. This development, it was inferred, would push downwards and forwards that portion of the cortex which on stimulation gives rise to eye movements in Macacus. Stimulation experiments by unipolar excitation are given in detail showing the correctness of this deduction; moreover, for the first time the excitable motor cortex is precisely mapped out in this animal. The experimental observations have been correlated with a histological survey of the cortex cerebri in front of the central fissure. Figures are given to show the distribution of two quite distinct types of cortex in the lateral surface of the Gibbon's brain in front of the central fissure corresponding to Campbell's precentral and intermediate precentral types, or to Brodmann's types 4 and 6. The great forward extension of the intermediate precentral area (especially that which may be described as the middle frontal convolutions) forms a most characteristic feature of the Gibbon's brain, and distinguishes it in a very striking way from the Orang and Chimpanzee on the one hand, and Cercopithecus and the Baboon on the other.—J. S. **Huxley**: Some phenomena of regeneration in Sycon, with a note on the structure of its collar-cells. *Production of normal individuals from isolated cells* (as in Wilson's experiments on Monaxonida).—Cells were obtained singly by straining sponges through gauze. They first unite into lumps, all the kinds being confusedly mixed (reunion). Next the dermal cells migrated to the surface to form a flat epithelium round a mass of quiescent collar-cells (reorganisation). Then came redevelopment: spicules arise, monaxons before triradiates; gastral cavity and osculum appear. The spicules form later than in the larva (where, however, they are certainly precocious), and the regenerates failed to fix permanently. Otherwise redevelopment resembled normal post-larval development. None became heterocœlous, though one lived and grew as a functioning sponge for several weeks. The fate of the cells here is *not* a function of their position, for they have to migrate into position before development can proceed. *Behaviour of pure collar-cells.*—If large bits of gastral epithelium are taken, they bend back and round up into perfect hollow spheres with collars directed *outwards*. Similar spheres were formed, but in a different way (with preliminary solid stage), if numerous single cells were taken. Though some lived more than a month, no other tissue was regenerated by them. These spheres have no bearing on phylogeny. Their structure is probably due only to oxygen requirements and to surface tension. Their failure to regenerate other tissue proves nothing against choanoflagellate ancestry; the ancestral cells may have given up their regenerative powers to others, more suited, as has happened elsewhere (*e.g.* Ascidians). *Collar-structure.*—Longitudinal rods do exist in the collar, as described by Bidder.—Dr. J. A. **Murray**: Imperial Cancer Research Fund. Cancerous ancestry and the incidence of cancer in mice. The present paper is in continuation of a previous communication (Roy. Soc. Proc., B, vol. lxxxi., 1909, p. 310). The analysis of the ancestry of 1600 mice bred in the laboratory has permitted their classification in two groups differing considerably in the incidence of cancer. Out of a total of 562 female mice which lived for six months or more, cancer had occurred in the mother, one or other grandmother, or all three in 340, and in them 62 developed cancer of the mamma (18·2 per cent.). In the remaining 222 mice in which cancer was absent from the maternal and grandmaternal ancestors, only 19 developed cancer of the mamma (8·6 per cent.). The group with recent cancerous ancestry is found on analysis to be more severely attacked at all age-periods than the non-cancerous group (cancerous ancestors remote). Detailed analysis of the ancestors enhances the importance of the differences. The differences exceed their standard errors sufficiently to render them significant. The predisposition is apparently not constitutional, but local, and is regarded as only one of the factors in the development of cancer.—Dr. R. Tanner **Hewlett**: Immunisation by means of bacterial endotoxins. The action of bacterial endotoxins in immunising against the corresponding living organisms has been investigated. Guinea-pigs were the animals employed. *Typhoid Endotoxin.*—Series of guinea-pigs were given single injections of the endotoxin, ranging from 0·01 mgrm. to 1·0 mgrm. Five to eleven weeks later the animals were injected with living typhoid culture; considerable protection was obtained, particularly with doses of 0·1 and 1·0 mgrm. The protection afforded by the endotoxin was better, and lasted longer than that conferred by a bacillary typhoid vaccine. *Cholera Endotoxin.*—Six guinea-pigs each received 0·25 mgrm. of the endotoxin, and all survived an injection of living cholera culture given eleven weeks later. *Diphtheria* and *Plague Endotoxins* similarly confer some protection against the living organisms. No immunising substance was obtained from the *Trypanosoma brucei*. The results suggest that bacterial endotoxins may be of considerable value as protective vaccines. The endotoxin solutions maintain their

activity for some weeks at least, probably for a much longer period. A few inoculations of typhoid and diphtheria endotoxins have been performed in the human subject. The inoculations cause some local reaction at the site of inoculation, but little general reaction. (The endotoxin solutions were prepared by the method described in Roy. Soc. Proc., B, vol. lxxxi., 1909, p. 325.)—J. E. **Barnard** and Dr. R. T. **Hewlett**: A method of disintegrating bacterial and other organic cells. Bacterial toxins are of two kinds, extra-cellular and intra-cellular. The former are excreted into the medium, *e.g.* beef broth, on which the organism is cultivated, so that by a process of filtration the organisms can be removed, and the toxin is obtained in the filtrate; but the majority of pathogenic micro-organisms do not excrete their toxins, at least to any extent, and the toxins are retained within and form integral parts of the cells of the organisms. One method of obtaining these toxins is mechanically to disintegrate the bacterial cell, so that the cell contents are expressed, and the apparatus here described accomplishes this. It consists essentially of a containing vessel, in which, by a suitable rotation of steel balls, the organisms are crushed. The principal conditions to be fulfilled in such an appliance are:—Approximately every cell should be brought under the grinding action. Little or no rise of temperature should take place. The disintegration must be carried out in a vessel which is sealed, so that, when dealing with pathogenic organisms, none can escape at any stage of the process. These conditions are, in the main, complied with in the apparatus described. Experiments indicate that by this method the cell-juices are obtained unaltered, and suitable for investigations on the chemical composition and properties of the bacterial proteins and other cell constituents. Also that, after the grinding process has been carried on for a sufficient time, practically no cells remain which can be properly stained by any recognised bacteriological method, and which therefore can be regarded as whole cells containing a normal quantity of cell-juice.

Physical Society, April 28.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. E. **Wilson**: High-tension electrostatic wattmeter. When using the electrometer as a wattmeter it is necessary (in order to secure accuracy) that the voltage impressed upon the quadrants shall not be less than a certain minimum depending upon the voltage to be impressed upon the moving system. When the latter voltage is of the order 10,000, the quadrants require a voltage larger than can economically be provided by a shunt. One is led, therefore, to consider intensifying devices. The "series" or "current" transformer, the secondary winding of which is closed on a non-inductive resistance, can be used to give fairly good results, but it is not accurate at all frequencies, and is dependent upon wave form. The author's quadrature transformer is a very simple piece of apparatus which can be relied upon to give for electrostatic wattmeters an electromotive force which is strictly the differential of the current in the primary winding. When so used it is necessary, for accuracy, at all frequencies and on all wave forms, that the integral of the mains voltage shall be impressed upon the moving system, although for sine curves only the differential need be impressed instead of the integral.—Dr. R. S. **Willows** and T. **Picton**: The behaviour of incandescent lime kathodes. Wehnelt has shown that incandescent lime emits a large number of negative ions; if, therefore, hot lime is used as the kathode, a discharge may be obtained in a vacuum tube with P.D.'s so low as 30 volts. The alteration with time of these kathodes, under continued use, has been investigated and the following results obtained:—(1) When lime is heated on platinum foil, so far from showing fatigue, it actually increases in activity. With P.D.'s greater than the saturation voltage this increase may be nine-fold. At lower voltages a slow but steady increase up to 100 per cent. has been found. The steady activity falls when the lime is cold; the initial activity may greatly increase. (2) When the lime is heated on nickel foil, if the tube carries a heavy discharge, the current increases to a maximum and then decreases. A greatly increased activity is frequently shown after the lime has been cold for some hours. At the lower voltages the same general variations are shown as with platinum. (3) Great irregularity is frequently shown when the current is first started; at this stage other causes than temperature, such as mechanical vibrations, greatly influence the emission of ions.—Dr. S. **Marsh** and W. H. **Nottage**: The formation of dust striations by an electric spark. The formation of dust striations by electric spark has been investigated by many observers. The paper attempts to explain their formation as being due to hydrodynamic forces existing between the dust particles while the wave motion is passing over them. The application of this theory to the striations in a Kundt's tube has been made by Kœnig and Robinson. The wave motion is assumed to be of the spherical progressive type, and expressions are obtained from the intervals between consecutive striæ and the distances of the striæ from origin. Measurements were made of striæ formed on a glass plate with vertical central spark. The agreement between theory and experiment is within the experimental error. Experiments with channels of various shapes were made. Illustrations of the various striæ patterns obtained with small obstacles and reflecting surfaces are given, and the use of these as a convenient means of indicating reflecting interference and diffraction of sound waves is pointed out.—Prof. E. **Wilson** and L. C. **Budd**: Previous magnetic history as affected by temperature.

PARIS.

Academy of Sciences, April 24.—M. Armand Gautier in the chair.—M. **de Forcrand**: The hydrates of potassium fluoride. The results of determinations of the solubilities and heats of solution of the fluorides of the alkalies and the alkaline earths are given. In addition to the hydrate $KF.2H_2O$ already known, the properties of a new hydrate, $KF.4H_2O$, are described.—G. **Tzitzéica**: Certain conjugated networks.—Francesco **Severi**: The simple integrals of the first species attached to an algebraic surface. —Henri **Villat**: The determination of certain discontinuous movements in fluids.—L. **Hartmann**: The mechanism of the permanent deformation in metals submitted to extension. The metal bar under tension is polished on one face, and this repolished at intervals during the gradual increase of the load. The method gives valuable information on the changes taking place in the bar above the elastic limit.— G. A. **Hemsalech**: Some spectral phenomena accompanying the displacement of the spark by a magnetic field. A study of the spectrum of the spark between calcium electrodes in a magnetic field, the metal poles being in an atmosphere of hydrogen. The spectrum obtained approaches that observed in the upper layers of the chromosphere of the sun.—M. **Gutton**: Experiments on the velocity of light in refractive media. In a preceding note the author has described a method for the comparison of the velocities of propagation of Hertzian waves and light in air. The same apparatus has now been applied to the measurement of the ratio of the velocities of light in air and liquids. These results are compared with the indices of refraction determined in the ordinary way, and the differences are shown to be in accord with the theory developed by M. Gouy in his memoirs on the propagation of light in media possessing dispersion.—M. **Guilleminot**: The intensity and quality of the X-rays diffused by aluminium plates of varying thickness (secondary rays).— Georges **Baume** and Georges **Pamfil**: The fusibility curves of gaseous mixtures, combinations of hydrochloric acid and sulphur dioxide with methyl alcohol. With the system methyl alcohol, hydrochloric acid, a clear mixture is shown at the composition corresponding to equal molecules. With sulphur dioxide two compounds are defined, CH_3OH,SO_2 and $2CH_3OH,SO_2$.—L. **Franchet**: The preparation of the black enamel of the Greek potteries by means of natural ferroso-ferric oxide. The black enamel of the ancient potteries was obtained with magnetite. The flux for this was probably made from silica and alkali salts.—D. **Gauthier**: Syntheses of the secondary α-ketonic alcohols. The only ketones of this type described up to the present have the composition R.CH(OH).CO.R. In the present paper a general method of preparing ketones of the type R_1.CH(OH).CO.R_2 is given. An aldehyde R_1.CO.H is treated with hydrocyanic acid, giving R_1.CH(OH).CN. In presence of two molecules of an organo-magnesium compound R_2.MgX, the alcohol ketone R_1.CH(OH).CO.R_2 is obtained.—Amé **Pictet** and Alphonse **Gams**: The synthesis of oxyberberine.—G. **Darzens** and J. **Sejourné**:

The condensation of ββ-dimethylglycidic ether with brom-acetic ether.—A. **de Schulten**: The crystallographic examination of some silicides, borides, and carbides obtained by Henri Moissan and his pupils. Data are given for the silicides of iron, cobalt, manganese and chromium, for aluminium and beryllium carbides and for calcium, barium and strontium borides.—L. **Blaringhem**: The production of a new form of maize by a traumatism.—Léon **Pigeon**: A new form of stereoscope. This instrument has been designed specially for the physiological study of vision, for the study and treatment of astigmatism, and for ophthalmological clinical work.—René **Cruchet** and M. **Moulinier**: Pathological conditions induced by aviation. A description of the changes in the arterial pressure and nervous system caused by aviation. The most serious cause of trouble appears to be due to a too rapid descent from a high altitude.—Henri **Piéron**: The regressive evolution of mnemonic traces.—R. **Robinson**: The relations between the suprarenal glands with the state of gravidity, and on the use of adrenaline in the vomiting of pregnancy. Two cases of vomiting due to pregnancy, resistant to all ordinary methods of treatment, were cured by treatment with adrenaline.—E. **Bataillon**: Experimental parthenogenesis in *Bufo vulgaris*.—Armand **Dehorne**: The number of the chromosomes in the parthogenetic larvæ of the frog.—A. **Railliet**, G. **Moussu**, and A. **Henry**: Researches on the treatment of distomatosis of the sheep. Of all the medical agents tried, the only one which gave clear positive results was the ethereal extract of male fern. Four doses of 5 grams appear to be the minimum for success.—MM. **Bordas** and **Touplain**: The estimation of phosphorus in milk. A reply to some criticisms of MM. Fleurent and L. Levi.—Alexandre **Lebedeff**: The extraction of zymose.—F. L. Pereira **de Sousa**: The tidal wave of the great earthquake of 1755 in Portugal.

DIARY OF SOCIETIES.

THURSDAY, MAY 11.

ROYAL SOCIETY, at 4.30.—On a Method of making Visible the Paths of Ionising Particles through a Gas: C. T. R. Wilson, F.R.S.—The Vertical Temperature Distribution in the Atmosphere over England, and some remarks on the General and Local Circulation: W. H. Dines, F.R.S.—On some Mineral Constituents of a Dusty Atmosphere: Prof. W. N. Hartley, F.R.S.—The Path of an Electron in Combined Radial Magnetic and Electric Fields: Dr. H. S. Allen.—On the Absolute Measurement of Light—a Proposal for an Ultimate Light Standard: Dr. R. A. Houston.—On Harmonic Expansions: Prof. A. C. Dixon. F.R.S.

ROYAL INSTITUTION, at 3.—The Optical Properties of Metallic Vapours: Prof. R. W. Wood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Driving of Winding Engines by Induction Motors: H. J. S. Heather.

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of a Model of a Deformable Octahedron: G. T. Bennett.—The Scattering of Light by a Large Conducting Sphere (Second Paper): J. W. Nicholson.

FRIDAY, MAY 12.

ROYAL INSTITUTION, at 9.—Biology and the Kinematograph: Prof. W. Stirling.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rotation of Stars about their Axes: George Forbes.—Parallax of 17 Lyræ C.: F. Slocum.—Positions of Halley's Comet and of Comet 1910*a*, from Photographs taken at the Khedivial Observatory, Helwân: H. Knox Shaw.—On the Harvard Eclipses of Jupiter's Satellite IV.: W. de Sitter.—Determination of the Moon's Parallax from Meridian Observations of the Crater Mösting A.: Royal Observatories, Greenwich and Cape of Good Hope.—Occultations observed during the Lunar Eclipse, 1898, December 27: Walter Heath.—*Probable Paper*: Discussion of the Greenwich Zenith Tube Observations, 1906–9: A. S. Eddington.

MALACOLOGICAL SOCIETY, at 8.—Some Remarks on the Nomenclature of the Veneridæ: Dr. W. H. Dall.—Description of a New Species of Conus from South Africa: G. B. Sowerby.—A Modification in the Form of a Shell (*Siphonaria Algesiræ*) apparently due to Locality: Rev. A. H. Cooke.

PHYSICAL SOCIETY, at 8.—Stream Lines Past the Elliptic Cylinder and Magnetic Interpretation: Sir George Greenhill and Col. R. E. Hippisley.—The Method of Constant Rate of Change of Flux as a Standard for Determining Magnetisation Curves of Iron: J. T. Morris and T. H. Langford.—Demonstration of an Electric Thermo Regulator: Prof. H. L. Callendar.

INSTITUTE OF METALS, at 8.30.—The Hard and Soft States in Metals: Dr. G. T. Beilby, F.R.S.

MONDAY, MAY 15.

ROYAL SOCIETY OF ARTS, at 8.—Rock Crystal: its Structure and Uses: Dr. A. E. H. Tutton, F.R.S.

TUESDAY, MAY 16.

ROYAL INSTITUTION, at 3.—The Brain and the Hand: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—River Life and People in Upper India: Percy B. Bramley.

ROYAL STATISTICAL SOCIETY, at 5.—On the Use of the "Normal Crop" as a Standard in Crop Reports: H. D. Vigor.—Seasonal Fluctuations in Employment in the Gas Industry: F. Popplewell.

WEDNESDAY, MAY 17.

ROYAL SOCIETY OF ARTS, at 8.—Les Basses Températures: Prof. Raoul Pictet.

ROYAL METEOROLOGICAL SOCIETY, at 4.—On the Frequency and Grouping of Wet Days in London: Dr. H. R. Mill and C. Salter.—Report on the Phenological Observations for 1910: E. Mawley.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Method of Disintegrating Bacteria and other Organic Cells: J. E. Barnard.—Structural Details of *Coscinodiscus asteromphalus*: T. W. Butcher.

THURSDAY, MAY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Inbreeding in a Simple Mendelian Stable Population with Special Reference to Cousin Marriage: S. M. Jacob.—The Properties of Colloidal Systems. II. On Adsorption as Preliminary to Chemical Reaction: Prof. W. M. Bayliss, F.R.S.—On Distribution and Action of Soluble Substances in Frogs deprived of their Circulatory Apparatus: S. J. Meltzer.—Transmission of Amakebe by means of *Rhipicephalus appendiculatus*, the Brown Tick: Dr. A. Theiler.—The Discrimination of Colour: Dr. F. W. Edridge-Green.—On the Direct Guaiacum Reaction given by Plant Extracts: Miss M. Wheldale.

ROYAL INSTITUTION, at 3.—Air and the Flying Machine. I. The Structure of the Atmosphere and the Texture of Air Currents: Dr. W. N. Shaw, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Principles of the Construction of Vegetation Maps: Dr. C. E. Moss.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Telephone Exchange Systems: W. Aitken.

FRIDAY, MAY 19.

ROYAL INSTITUTION, at 9.—Recent Experiments with Invisible Light: Prof. R. W. Wood.

SATURDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Phases of Bird Life. I. Flight: W. P. Pycraft.

CONTENTS.

THURSDAY, MAY 18, 1911.

THE NORTH POLE.

The North Pole. By Robert E. Peary. With an introduction by Theodore Roosevelt. Pp. xii+326. (London: Hodder and Stoughton, 1910.) Price 25*s*. net.

PEARY'S narrative of the journey by which he reached the North Pole and satisfied his life's ambition cannot fail to command the respect of all who appreciate indomitable perseverance, high courage, and unfaltering devotion to an ideal. Peary cheerfully accepted months of drudgery, for although he describes life on the march in the Arctic as a dog's life, he regards the work as a man's work; and although he met with repeated disappointment—for beating the northern record without reaching the pole he despises as an empty bauble—his devotion was at length rewarded by well-earned success. Peary's last journey will probably always be his most famous, for it accomplished one of the greatest geographical quests; but its results are probably of less real geographical value than his exploration of northern Greenland, one of the most important of Arctic achievements.

Peary's book on the whole is disappointing. Its form at once arouses the prejudice of those who do not buy books by bulk. It is unnecessarily large, its size is increased by some illustrations which are neither instructive nor ornamental, and by the use of vast margins to the pages. The book is issued regardless of the congested conditions of most people's bookshelves, and is apparently intended for those who can find space for works with a large proportion of blank paper. The book has obviously been prepared in haste; the illustrations are in no particular order, and their titles cannot have been corrected by the author. Thus the view of the stone cairn, entitled "Camp Morris K. Jessup," that is, the camp at the North Pole, should be "Cape Morris K. Jessup," a mistake which might give rise to a serious misunderstanding. There is a map, inconveniently large, from which Crocker Land, one of Peary's most suggestive discoveries, has been omitted.

The book has no particular literary charm, although it is occasionally enlivened by touches of American humour, such as the statement that the atmosphere in Eskimo huts can be handled with a shovel.

The most interesting part of the book is the description of the Eskimo whose Mongolian affinities Admiral Peary clearly recognises. The account shows the author's tendency to judge everything by Arctic standards. Thus because the fair-skinned Eskimo were not as much impressed by white men as were some dark races, Peary dismisses with scorn the idea that any aborigines regarded the first Europeans they saw as superhuman. "Much nonsense," he says (p. 53), "has been told by travellers in remote lands about the aborigines regarding as gods the white men who come to them, but I have never placed much credence in these stories."

The book tells in detail the story of the expedition and its equipment; but in spite of the space available there are many omissions of the very things one would most like to know. Thus Peary claims that the success of his dash to the pole was only possible owing to the new sledges and portable stove that he designed for the expedition. He does not give future travellers the benefit of any descriptions of these instruments and their novel features. There is also little in this book to answer the criticism of those who have questioned Peary's actual attainment of the pole. There is an appendix by Mr. Henry Gannett, Admiral Chester, and Mr. O. H. Tittman, who state that they have examined Peary's journal and records, and they are unanimously of the opinion that he reached the pole. Some adequate statement of the evidence that was laid before these distinguished authorities might have been given as one of the appendices, of which there are three. There is no reason to distrust the fact that Peary reached the pole, or sufficiently near it for any practical purpose. The great increase in his pace after he parted from Captain Bartlett is not explained in the text, but the photographs of the area round the pole show wide stretches of smooth ice, hence exceptionally easy ice conditions may account for the speed of the final marches.

It is not easy to follow the story of the last few days of the approach to the pole, especially as the continuous daylight renders his references to morning and evening less helpful than they would be in following an ordinary itinerary. A tabular statement of his marches would have been very useful. The numerous references to the observations taken and the facsimiles of some of the calculations are not convincing, especially as a curious statement on p. 241 suggests that Peary has only a rule of thumb acquaintance with astronomical methods. He remarks that he had to strain every nerve to arrive at the pole by noon, so that he could at once take an observation for latitude; but at the pole the sun would be moving round at nearly a constant altitude, so that any time would have served for the observations, and time would not enter into the computation.

The author gives an interesting description of the arduous voyage up and down Kennedy Channel. He tells us that only four ships have made this dangerous passage, and of these one was lost and two were badly damaged. Peary's experiences show that Sir George Nares's successful navigation of this channel in the *Alert* is a feat which has not received the credit it deserves.

The most interesting geographical contribution in the book is the discussion by Mr. R. A. Harris, of the United States Coast Survey, of the bathymetric and tidal observations. The soundings taken show that a continental shelf covered by 100 fathoms of water extends for forty-six miles north of Grant Land. From the edge of this shelf, the sea deepens rapidly to 825 fathoms, but it then becomes shallower again to the north, and the depth lessens to 310

fathoms; the sea deepens again, and Peary's soundings found no bottom at 1500 fathoms. The existence of this shallow ridge has an important bearing on the possible existence of land further to the west. This question is discussed by Mr. Harris, and he concludes from the tidal evidence, and the fact that the flood at Point Barrow comes from the west and not from the north, that there must be a wide area of land or of island strewn sea to the west of the Arctic Archipelago. He estimates that there is an area of nearly half a million square miles either of land, of islands, or of shoals still undiscovered in the Arctic Ocean to the north of the western part of North America and of eastern Asia. Mr. Harris suggests that this land must extend from north of Bennett Land, which is to the north of Siberia, eastward to Crocker Land, and with Peary's attainment of the pole the settlement of this problem is the most interesting geographical question left in the Arctic Ocean.

ENERGY AND THE ORGANISM.

Vicious Circles in Disease. By Dr. J. B. Hurry. Pp. xiv+186. (London: J. and A. Churchill, 1911.) Price 6s. net.

A FEW days before this volume was placed in the hands of the reviewer he had been watching for a few minutes the race of a small brook into a larger but more sluggish stream. Curiously near the inrush a wisp of straws lay almost at rest, circling slowly round and round, but not swept with other wisps and leaves into the main current. This arrest was due to a still but deep whirlpool formed by the different velocities of the waters at the angle of meeting. Light objects which skirted this eddy swiftly vanished on their way to the sea; those caught in it were imprisoned. However, by placing a walking stick tangentially to the eddy, now one straw, now another, would dart aside, and, catching a streak of the main current, would speed off into liberty.

This humble little parable may serve to illustrate Dr. Hurry's interesting volume on vicious circles of disease. The author's message may be summed up thus: In health the confluent or congruent streams of energy should work in reciprocal harmony for the several ends of the organism as a whole; but in disorder this agent or that, alien or home-grown, may strike tangentially upon one or more of such streams and form a vortex, twisting the lines of function and setting up, in one or more situations, a focus of wasting energy, and, it may be, a trap for alien or degraded products which should be run out of the system. Now at some point in this circle the gyrating lines may be cut, the eddy may be diverted, and the lines of energy released to their normal directions. The hound which had turned to hunting its own tail may be put again on the track.

Among the absurd axioms which we are apt to repeat without thought is that which unconditionally impugns the practical impulse to "treat symptoms"; but in the majority of cases—in all for which we have no specific antidote—no other course is open to the practitioner. Moreover, even where we have such a specific, to refrain from treating symptoms, if the physician's, is not the patient's point of view. He asks for cure; but also for relief. Now these observations and maxims of Dr. Hurry emphasise a further truth—that in so doing we may be cutting across—at any point, it matters not where—a "vicious circle." To disperse a vortex, expending energy in mere friction, may serve even to disperse the malady; at least it may moderate its intensity, or dispel vexatious symptoms. But often the whole trouble consists in such a vortex, and in a single one; in these cases, therefore, of which the author gives many an instructive instance, to treat a symptom is to cure a disease; for the conception of disease as an "entity" ought to be banished even from the language of the modern physician. Sometimes it is the knife which must take the place of the walking stick of the parable; but happily milder means often suffice to divert the currents into the normal channels, but not, as Dr. Hurry inadvertently says (p. 167), to "reverse" the circular movement. This cannot happen—or, more accurately, never does. Evolution never returns by the way it came.

There is one more demur. Dr. Hurry seems scarcely to realise, or fully to impress upon us, the factor of "organic memory" in these phases of function, the bent of biological matter to repeat what it has done before; a faculty on which development and purpose depend. In vicious circles every gyration deepens the groove, an abnormal habit is formed, so that arrest of such a local waste of energy and such a distress becomes more and more difficult; herein enters the problem of "faith healing," of the stronger tangential force which is to dissipate the vortex and redistribute the currents of energy. The longer the "habit"—the fixture of organic memory—the harder the impulse needed to "break the circle," for the habit has become independent of the original cause, which indeed had often vanished.

Dr. Hurry does not pretend for a moment to have discovered this notion of vicious circles, but he has made it his own; it is one often remarked upon by medical practitioners, but no one has presented the subject systematically to us before in a printed book. But both in lectures and practice I remember that the Teales, of Leeds—especially Mr. Pridgin Teale—taught the principle emphatically, and, if they did not publish the experience, put it variously into practice. And so it has been, no doubt, with many another physician; but of this the author is well aware, while he has himself the merit of perceiving the need of a systematic study of the problem, of adapting the principle with much ingenuity to explain many morbid conditions, and of illustrating the practice by interesting examples. Out of his careful clinical studies and large experience Dr. Hurry is justified in pointing to the great array of evidence which he has brought forward in his chapters on the systems of the body, and formulated in diagram, and in declaring that this aspect of medicine "is one which no practitioner of the *ars medendi* can afford to neglect."

C. ALLBUTT.

ALCHEMY, ANCIENT AND MODERN.

Alchemy: Ancient and Modern: Being a Brief Account of the Alchemistic Doctrines, and their Relations, to Mysticism on the One Hand, and to Recent Discoveries in Physical Science on the Other Hand, together with some particulars regarding the Lives and Teachings of the most noted Alchemists. By H. Stanley Redgrove. Pp. xiv+141. (London: W. Rider and Son, Ltd., 1911.) Price 4*s*. 6*d*. net.

THE author of this book thinks he perceives in the trend of modern chemical doctrine an approximation to the fundamental dogmas of philosophical alchemy, as these were understood and taught by its greatest exponents. The application of the principles of evolution to the genesis of the chemical elements has, in his opinion, brought us back to the "basic idea" permeating all alchemistic theory, and that, in his judgment, the time is gone when it may be regarded as legitimate to point to alchemy as an instance of the aberrations of the human mind. How far the general proposition is, or can be, substantiated by the facts of experiment at present known to us, may be seriously questioned. It is practically certain that no proof of transmutation has ever been given. Allegations of such an occurrence have been made, of course, times without number. But whenever any instance of the kind has been properly scrutinised, the allegation has been wholly disproved, and the evidence that it has been made in bad faith and as the result of conscious fraud, and not merely of honest self-deception, is, in a large number of instances, complete and irrefutable.

Does the evidence to be obtained from modern experimental inquiry place the "basic idea" on any surer foundation? Mr. Redgrove evidently thinks it does. Otherwise the *raison d'être* of his book is gone. He is, he tells us, not only a student of chemistry, but also of "what may be generalised under the terms Mysticism and Transcendentalism"; and he hopes that this unusual combination of studies has enabled him to take what he calls a broad-minded view of the theories of the alchemists, and to adopt a sympathetic attitude towards them. No one can possibly object to Mr. Redgrove taking a broad-minded view of anything—certainly not of chemical theory, whether ancient or modern. But theories in chemistry stand or fall by facts. The ancient alchemists certainly never proved their theories. Have the modern alchemists done any better?

That there is such a thing as the philosophy of alchemy is undoubted. Some of the earlier followers of the art were men whose names are not merely hallowed by a hoary antiquity, but who are known from their writings and by the testimony of their contemporaries to be earnest, thoughtful philosophers, actuated by the true spirit of science. It is difficult to believe that such men were not influenced by some guiding principle, and that they followed their calling simply as empirics. That many of them were churchmen, and some of them mystics, has lent colour to the supposition that they regarded alchemy as a form of transcendentalism, and the general character of certain of their writings may be pointed to in proof of such a view. But although at various periods in the history of alchemy there were men—John Dee was such a man—whose conduct and mode of study were largely influenced by their predilection towards occultism, it is quite certain that by far the greater number of adepts were swayed by the most mundane and even the most sordid of considerations. However desirous we may be to share Mr. Redgrove's sympathy and broad-mindedness, we fail to perceive that he has done anything towards the elucidation of the philosophy of alchemy. He has advanced no view that has not already been presented and examined, and he has given no facts that are not to be found in other works, such as those of Kopp, Hoefer, Figuier, Gerding, or the more recent publications of Mr. Waite. Davy once said that analogy was the fruitful parent of error. The author has been actuated by an analogy which is fundamentally unsound and treacherous.

There is really no evidence that modern science is permeated by the spirit of alchemy, and, therefore, strictly speaking, there is no meaning in the phrase "modern alchemy." The fact is, Mr. Redgrove has been led away by an inconstant and wandering affection. He will learn in time, if he does not already know it, that he cannot serve two mistresses, and that he had better be off with the old love before he is on with the new. At the moment his true love for chemistry has been somewhat obscured by an illicit, but we trust transient, affection for that Delilah named Mysticism, and the present book is apparently the product of his mixed emotions. He had better return to chemistry, and give her his undivided allegiance. As he knows her more thoroughly he will learn to appreciate her whole-heartedly. There is not much romantic fascination about her; she has nothing of the glamour of mysticism; indeed, she tends to be rather matter-of-fact, but then that is one of her strongest points.

There is a certain type of mind from which the facts slip off like the proverbial water from the duck's back, but which nevertheless prides itself on its receptivity for "broad views." The views are frequently made so very broad that they have actually no depth. It is only to this type of mind that Mr. Redgrove's book can appeal.

THEORIES OF THE AETHER.

A History of the Theories of Aether and Electricity from the Age of Descartes to the Close of the Nineteenth Century. By Dr. E. T. Whittaker, F.R.S. Pp. xiv+475. (London: Longmans, Green and Co.; Dublin: Hodges, Figgis and Co., Ltd., 1910.) Price 12*s*. 6*d*. net.

WHEN we turn to an historical survey of electrical theory we are usually entertained by reprints showing scenes like the Abbé Nollet demonstrating the properties of an electrified boy, but the present work contains more satisfactory evidences of first-hand knowledge of the authorities. It traces carefully the growth, during three centuries, of optical and electrical science, more especially in rela-

tion to the theory of the æther. As regards mathematical calculations, space is saved by expressing results in vector notation, as well as by numerous references to the original memoirs; the treatment of the more important advances, without being exhaustive, is sufficiently adequate to define them clearly in their historical setting, that being the proper function of a work of this type.

Two-thirds of the book are devoted to the period ranging from Descartes to Maxwell. For most students this will probably be the more valuable portion, epitomising work which is not easily accessible.

Dr. Whittaker makes an interesting addition to the history of the law of electrostatic attraction between two charged particles. The law of inverse square of the distance is commonly ascribed to Coulomb, on account of his direct verification by means of the torsion balance (1785). When the researches of the Hon. Henry Cavendish were edited by Maxwell in 1879, it was seen that the same law had been established by a different method as early as 1773; on referring to early literature, such as Young's "Lectures," it appeared that the unpublished work of Cavendish was quite unknown to his contemporaries. Dr. Whittaker directs attention to a still earlier statement in Priestley's "History of Electricity," published in 1767. It appears that Priestley, following Franklin, had made experiments which showed that, when a hollow metallic vessel is electrified, there is no charge on the inner surface, and no electric force in the air inside. Priestley then continues:

"May we not infer from this experiment that the attraction of electricity is subject to the same laws with that of gravitation, and is therefore according to the squares of the distances; since it is easily demonstrated that were the earth in the form of a shell, a body in the inside of it would not be attracted to one side more than another?"

The chapter on elastic solid theories covers an important period. Cauchy, who was first in the field, obtains full credit for his various theories; although one sees how his work failed to stimulate later writers, especially of the English school. Dr. Whittaker remarks that his point of view in the earlier theories appears to have been: Given the equations of vibration of an elastic solid, what boundary conditions must be used in order to obtain Fresnel's results? It was Green who first showed that with a properly localised energy function, the Lagrangian method gave not only the equations of motion, but also the correct boundary conditions.

Some attention is paid to the æther of Cauchy's third theory of reflection, better known as the contractile æther of Lord Kelvin. The form of energy function used by Lord Kelvin might have been noticed; after beginning with the ordinary form for an elastic solid, he transformed it, by integrating by parts, into a form similar to that of MacCullagh's theory. One would consider this form as properly localised, not for the contractile æther, but for a medium specified to be rotationally elastic.

In the later portion of the book mechanical theories are treated further under the more modest description of models of the æther; there are also chapters on the followers of Maxwell, on conduction in solutions and gases, and on more recent theories of æther and electrons. These give a general account of various lines of advance since the time of Maxwell; in particular one notices the problem of relative motion of the earth and the æther, leading to a consideration of the nature of systems of measurement of space and time. The period of the book closes with the æther still endowed with a certain degree of substantiality, however different it may be from ordinary matter. In view of more recent developments based on the theory of relativity, Dr. Whittaker's treatise appears at an opportune time; it forms an important and valuable aid to a comparative study of theories of the æther.

T. H. H.

DISEASES OF ECONOMIC PLANTS.

Diseases of Economic Plants. By Prof. F. L. Stevens and J. G. Hall. Pp. x+513. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 8*s.* 6*d.* net.

THIS book is primarily intended for those who wish to recognise—without having recourse to the microscope—and then to combat fungous diseases of cultivated plants. Descriptions are given of the prominent characteristics of the most destructive diseases of fruit and vegetables cultivated in the United States, as well as information regarding the latest methods of prevention or cure. All the best bulletins of the numerous State agricultural experimental stations and of the U.S. Department of Agriculture have been examined for facts; the authors have had the help also of various specialists in reading over the proofs of certain parts, *e.g.* Dr. Erwin F. Smith has thus assisted with the bacterial diseases, Dr. L. R. Jones with potato diseases, and so forth. Short, clear, scientific descriptions are given of the various life-stages of the species of fungi causing plant diseases; these are accompanied by practical advice as to the methods to be employed against each stage by the grower. In many cases, *e.g.* in that of the onion "smut" and of the "common scab" of the potato, and of the various diseases of the apple, the account given is a model of what should be provided by the man of science for the practical man. Clear directions are given for the making and application of fungicides, and also useful information on the subject of spraying machinery. It would have been well, however, to have supplied fuller information on the subject of "Bordeaux injury," and how it may be avoided. Practical details are given of the disinfection of seeds by the use of formaldehyde gas, and the various methods of soil disinfection are discussed. It is pointed out that the presence in land of such ineradicable soil diseases as the melon, cowpea, cotton, or tobacco "wilt," onion "smut," cabbage "black rot," &c., may result in a depreciation of 50 per cent. or more in the market value of the land. In dealing with many of the diseases of cereals, pea, bean, lettuce, celery, potato, carnation, violet, asparagus, grape, strawberry, and other fruits the authors are not content with merely

stating that "resistant" varieties or "strains" should be grown but in all cases mention the names of such "resistant" varieties obtainable on the market. Such practical information is likely to be of great value to the market grower or gardener; it must be admitted that such assistance as this is not yet able to be given in this country, except in a few cases, by the man of science to the grower.

Throughout the book we find instances given of fungous diseases of different crops which have become epidemic in various districts in the States and caused serious money losses; on the other hand, we have detailed evidence given showing that such losses may often be avoided by careful and thorough spraying with the right fungicide at the right time. The annual loss caused by potato "blight" in the United States is estimated at 36,000,000 dollars; that caused by wheat "rust," 67,000,000 dollars. Turning to horticultural crops, we are told that the violet "leaf-spot" caused, in 1900, a loss of 200,000 dollars; the celery "leaf-spot"—which for the past three seasons has been causing havoc in several counties in this country—is stated to have caused a loss, in California, in 1908, of 1950 car-loads, and a money loss of 550,000 dollars. An interesting account is given of the gradual invasion of the States since 1896 by the asparagus "rust"; it is now known in every State where asparagus is grown—

"In some States the invasion of this disease has almost, if not quite, prohibited commercial asparagus growing. . . . The Palmetto varieties are quite resistant, and offer a solution of the rust problem in some localities."

Of the American gooseberry mildew (which we may remember has, since its introduction into Europe, about 1900, now spread over the whole of Ireland and England) it is said:—

"This disease has quite prohibited the cultivation of the finer sorts of English gooseberries in America, and is a grave menace to the culture of gooseberries in Europe."

One or two points of purely scientific interest may be noted. The statement is made that the pea mildew (*Erysiphe polygoni*) hibernates in seed derived from affected pods, and that the celery "leaf-spot" (*Septoria petroselini*, var. *Apii*) is probably carried by the seed of celery. The mistake is made of identifying the mildew on cucumber, cantaloupes, and musk-melons with *Erysiphe polygoni*, although Reed's interesting work on the specialisation of parasitism shown by this mildew—which this mycologist correctly referred to *E. Cichoracearum*—was recently published in the States. In place of *Podosphaera* the misprint *Podosphaeria* (with the "popular" (!) name "podosphæriose") appears three times; also the erroneous name of *Sphaerotheca mali* is continued for the apple mildew, and the mistake made of supposing that *Podosphaera leucotricha*—of which *S. mali* is a synonym—is a distinct species.

The book is very well illustrated, and the writing remarkably clear and to the point. There is one touch of pedantry—quite out of place in such a practical book as this—against which a strong protest must be raised—the attempt to create "popular" names derived from the generic name of the fungus causing the disease. Thus we have "Sphæropsose" proposed for "black rot," caused by *Sphaeropsis*, and such verbal monstrosities as "pseudomonose," "lasiodiplose," "merуliose," &c.

A chapter on the legislative regulations—Federal and inter-State—in force in America might have been added to make the admirable thoroughness of this book quite complete. As it is, this book should be in the hands of all the officials—both the Board of Agriculture's inspectors and the inspectors of the various county councils—who are now engaged in England in the work of combating fungous diseases under the provisions of the "Destructive Insects and Pests Act." The importance of the need to create a more enlightened public opinion on matters connected with plant protection and plant sanitation is rightly insisted upon in this book; as its authors say:—"To create a much-needed, enlightened, aggressive public opinion is part of the duty of plant pathology."

E. S. S.

ELEMENTARY MATHEMATICS.

(1) *A Class Book of Trigonometry.* By Dr. C. Davison. Pp. viii+200. (London: Cambridge University Press, 1910.) Price 3*s*.

(2) *The Student's Arithmetic.* By W. M. Baker and A. A. Bourne. Pp. viii+328+1. (London: G. Bell and Sons, Ltd., 1910.) Price 2*s*. 6*d*.

(3) *First-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Third edition. Pp. xii+365. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1909.) Price 4*s*. net.

(4) *Second-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Pp. xiv+282. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1910.) Price 6*s*. net.

(5) *Geometric Exercises for Algebraic Solution. Second-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Second impression. Pp. ix+71. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1909.) Price 3*s*. 6*d*. net.

(1) THE introductory course provided by this text-book includes the solution of triangles, omitting the ambiguous case, applications to the geometry of the triangle and quadrilateral, and easy problems in surveying. Complicated identities are excluded on the ground that they belong to the programme of the specialist rather than the amateur for whose use this is primarily intended. The general character of the book will probably be considered unduly conservative. It fails to take cognisance of the recent movement affecting the teaching of trigonometry. There is scarcely as much numerical work as many teachers will require, and the quality of the problems, which profess to be practical, is distinctly poor. The best feature of the book is the material provided for oral work, which will be found invaluable for class purposes.

(2) This is an abbreviated edition of the "Public School Arithmetic," by the same authors. The number of examples worked out in detail has been materially diminished on the ground that the average boy is apt to rely too much on this form of assistance and so avoids the necessity of thinking for himself. This is, of course, a matter of opinion. It is not at all an easy thing to train students to read for themselves; in general they are far too prone to rely on oral help. In more advanced work, it is unquestionable that there is a real educational value in forcing a boy to find out for himself the meaning of what the text-book is explaining, provided only that the book itself is a good one. Of course, progress is made more slowly in these circumstances, but the substance of what is read is more likely to be digested owing to the increase of mental effort. It is, however, hard to decide at what stage this recourse to books should be encouraged. The present volume gives a very thorough account of all branches of the subject. Indeed, in our opinion it contains far more than it is desirable for the average boy to know. The time required for mastering its contents is so considerable that it will leave small opportunity for proceeding to more fruitful work. But so long as an exhaustive study of the subject is required by examining bodies, it will be necessary for writers to meet this demand. In this the present volume is eminently successful.

(3) and (4) In the opinion of the authors of this treatise, which is issued in two volumes, the subjects of algebra and geometry should be fused together as far as possible. It is suggested that students are more likely to realise the relations which subsist between these two portions of elementary mathematics, if a single text-book is placed in their hands. An examination of the contents of the separate volumes shows that algebra predominates in the first and geometry in the second; but in each case it is true to say that the correlation of the two subjects is kept consistently in view. The first course includes the elements of algebra up to simultaneous linear equations, factors, and fractions, and the fundamental ideas of geometry, viz., congruence, parallelism, and similarity, with numerical illustrations and straightforward constructions. The principle of moments is used to provide some interesting algebraic problems. The advanced course contains a more systematic account of formal geometry, the properties of the circle, theorems on areas and similar figures, the investigation of regular polygons, and more difficult constructions. With this is combined the general solution of the quadratic, the algebraic theory of proportion, graphical algebra, and simple numerical trigonometry restricted mainly to right-angled triangles. The manipulation which is expected from the student is of a simple character. This is probably the best plan for students of the age for which this book is designed. But we doubt whether it is equally desirable to exclude at the same time anything which can be properly called a rider. Numerical work in geometry provides the most certain means of elucidating new ideas, but unless this is combined with a certain amount of theoretical work, the intrinsic value of the subject is sacrificed. The ability to solve a simple rider is the best index of the intellectual growth of the student.

(5) The title of this book is an adequate description of its contents. It consists of about eight hundred examples, illustrating the theorems of elementary plane and solid geometry, and it yields a collection of questions which many will find a useful supplement to formal treatises.

OUR BOOK SHELF.

Ornitologia Argentina. Catálogo sistemático y descriptivo de las Aves de la República Argentina. By Dr. R. Dabbene. Tome Primers. Pp. xiv+513. (Buenos Aires: Museo Nacional, 1910.)

THE object of the present work, of which the volume before us is only the first, is to provide, as we learn from the preface, a systematic list of all the genera and species of birds inhabiting Argentina, mainly from the point of view of their geographical distribution, for the use, chiefly, of students of ornithology in the Republic. Most of the species common to the neighbouring countries of Brazil, Bolivia, Paraguay, and of the frontiers of Chili and Uruguay are included, since it is highly probable that the birds of these regions will be discovered in the Argentine when it is more fully explored. Included also are all the species inhabiting the archipelagoes and islands lying off the shores, as well as the lands extending southward to the Antarctic circle.

The work is to contain three parts. The first deals with those anatomical characters of birds which are of classificatory value. The second discusses the geographical distribution of the birds of the Republic, with a list in systematic order of all its recent and fossil species, and their assignation to the different zones—shown on a coloured map—into which the author divides the region. The final section, to be dealt with in future volumes, will contain brief diagnoses of the orders and families, &c., of birds represented in the Argentine, with keys for differentiating the species, which number 409, referable to 71 families. An extensive bibliography is appended to each section.

Although Dr. Dabbene is largely indebted, with due acknowledgment, for his morphological facts to European investigators, and among English workers especially to Huxley, Garrod, Forbes, Beddard, Chalmers Mitchell, Garrod, and Newton—from whose works most of his figures are derived, the volume will be of very great value to students so disadvantageously remote from the great European libraries and books of reference, as are those domiciled in Argentina. The section devoted to geographical distribution brings concisely together the data under this head, and will be appreciated by those elsewhere interested in South American ornithology. The volume is provided with very full indices.

Die Samenpflanzen (Blütenpflanzen, Phanerogamen). By Prof. K. Wilhelm. Pp. xvi+151. (Wien and Leipzig: F. Deuticke, 1910.)

THERE can be no disagreement with the author's opinion that the only satisfactory method of acquiring a knowledge of plant classification is to practise the determination of unknown species with the aid of a flora or other systematic compilation. It has been Dr. Wilhelm's object to supply a compilation suitable for the use of foresters, agricultural, pharmaceutical, and other technical students. The chief essentials for such a work appear to be a differentiation,

if possible analytically disposed into orders—better known as "cohorts"—a good description of the families, and an indication of important characters for leading genera. This requires a work of some magnitude, but not more extensive than Warming's "Systematic Botany," which follows these lines. Wilhelm's "Samenpflanzen" defines orders and families, and in the case of large families supplies discriminating characters for subfamilies, but only in occasional instances provides the necessary information for identifying genera.

The arrangement adopted is a modified Eichler-Engler system, prepared by Prof. R. Wettstein for his "Handbuch der systematischen Botanik," but the diagnostic characters have been redrafted by Dr. Wilhelm. A very valuable feature in the former book is the series of notes pointing out the probable relationships and affinities between various families, thus furnishing an important key to the system; a similar phylogenetic guide would be useful for the book under notice. The plants enumerated include European species, those yielding economic products, and timber trees; by the adoption of different printing types it is intended to give an idea of the comparative importance of the various genera. The lists are, so far as observed, both full and accurate.

The Past at Our Doors, or the Old in the New Around Us. By W. W. Skeat. Pp. xi+198. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

IN this interesting little book Mr. Skeat shows how the past is not only at our doors, but upon our lips. Confining himself in the main to the subjects of food, dress, and the home, he brings together a multitude of facts bearing upon the history of the common objects and events of our domestic environment. The etymological bias is marked, but excusable—perhaps even inherited—and Mr. Skeat does not fail to emphasise the influence of our ancestors upon our deeds, as well as upon our words.

In the "Story of Our Food" the range is from meal times and their names, through the apparatus of the table, to hunting, ploughing, and the preparation of food, with other matters taken by the way. The section on "Dress" follows the general lines of recent works on the subject, and is more fully illustrated than the rest of the volume. The "Story of Our Homes" is chiefly an account of the evolution of the modern dwelling-house, including such furniture as cupboards, dressers, wall-hangings, carpets, and beds.

In view of the great variety of subjects discussed in a small space, some degree of discontinuity was unavoidable, and the book has the character of a work of reference on a small scale. If it is pemmican, it is good pemmican, and full value for the money.

H. S. H.

Serum and Vaccine Therapy. Bacterial Therapeutics and Prophylaxis Bacterial Diagnostic Agents. By Prof. R. T. Hewlett. Second edition. Pp. x+406. (London: J. and A. Churchill, 1910.) Price 7*s.* 6*d.* net.

THE second edition of Prof. Hewlett's book on serum-therapy, which has just appeared, does not claim to give more than an outline of the mode of preparation and employment of the therapeutic sera and vaccines. As such it ought to prove of service to the student or busy practitioner, who may not have the opportunity or the time to consult the larger works on this subject. It is doubtful, however, if the author has been entirely successful in his effort to condense the subject, for the requirements of the interested medical reader. The authorities quoted, though few, are not always the most authoritative, and their opinions are too frequently referred to without criticism or comment. A good account is given of the preparation of the antitoxins for diphtheria and tetanus and antivenin. Referring to the employment of antitoxin as a prophylactic against diphtheria, the author is apparently impressed with the objections raised against it on the ground that an anaphylactic state may be induced, and he thinks that a diphtheria-endotoxin, which he is at present elaborating, may prove an efficient substitute for antitoxic serum in prophylaxis. The appearance of this preparation will be awaited with interest by the medical profession. The intracerebral injection of tetanus antitoxin is recommended as the method which gives most hope of success in cases which have lasted any length of time, but it does not seem that trustworthy data on this question are available.

More space might have been devoted to the use of tetanus antitoxin as a prophylactic and to the anti-meningococcal and antidysentery sera, both of which have proved of the highest value in practice, and in point of efficiency should follow closely after diphtheria antitoxin.

Other sera, such as antipneumococcic and antityphoid, have more space devoted to them than their importance at present warrants.

Vaccine-therapy receives adequate treatment at the author's hands, but it is somewhat curious that the account should be prefaced by a dissertation on opsonins. These substances should surely take their place in the general scheme of antibodies called forth in response to immunisation.

The closing chapters of the book deal with the preparation of calf lymph, typhoid vaccine, mallein, tuberculin, and sour milk.

We observe at the close of the book certain trade advertisements, the majority of which deal with soured milk or cheese. These appear somewhat out of place in a scientific treatise.

Handbook of American Indians north of Mexico. Edited by F. W. Hodge. In two parts; part ii., N–Z. Pp. iv+1221. (Smithsonian Institution, Bureau of American Ethnology, Bulletin 30.) (Washington: Government Printing Office, 1910.)

THE second and concluding volume of the "Handbook of American Indians north of Mexico" has followed three years after the publication of the first volume. It consists of more than a thousand pages of closely printed matter in double columns; there is in addition a synonymy of 158 pages and an extensive bibliography; unfortunately, the latter is not quite complete. For example, Mr. C. Hill-Tout's papers on the Salish in the *Journal* of the Royal Anthropological Institute and Reports of the British Association, and his book on "British North America—I., the Far West" (1907), are totally ignored, both here and in the article "Salish." It is impossible to review a book of this kind as it is composed of an enormous number of notes and short articles written by experts, of whom fifty-four were employed on this volume alone. The information is given succinctly, and in most cases an adequate bibliography is added at the end of each article. There is as large a number of illustrations as space permitted. All those interested in North American ethnology and archæology will appreciate the value of authoritative statements on disputed points, and the references for further information thereon. It is also a great convenience to be able to discover the synonymy of a tribe and to be informed as to what may be regarded as its official designation. As a book of reference it is simply invaluable, and it should find a place in every public library; every ethnologist will procure a copy as a matter of course.

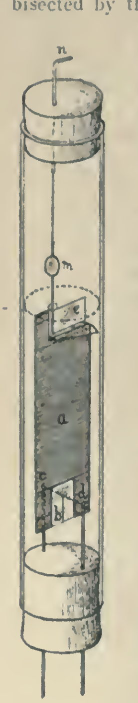
LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Thomson and Peltier Effects.

A MODIFIED Joule radiometer has been applied successfully to show the existence of the Thomson effect in copper and the Peltier effect at the junction of two dissimilar metals.

The lower part of a vertical glass tube 3 cm. in diameter was divided into two compartments by a cardboard diaphragm *a*, 12 cm. long. A rectangular strip was cut away from the upper part of the partition, and a mica plate, *b*, was substituted for a similar strip from the lower part. A thin copper wire *cd*, No. 36, was soldered to two thick copper leads, No. 16, fixed into a cork. The wire *cd* was passed through a slit in the mica plate *b*, and the cork was pushed to within 1 cm. of the lower edge of the partition. The wire *cd* was arranged so that it was nearly bisected by the mica plate. A mica vane *e* attached to an aluminium wire was suspended by a quartz fibre within the aperture in the upper part of the partition. A horizontal disc of cardboard, shown dotted in the figure, was fixed to the upper cork by a pair of rods, and fitted inside the tube just above the vane. A horizontal sector-shaped plate of mica was fastened to the partition just below the vane to complete a channel for the current of air from the warm to the cool side of the partition. The clearance between the edges of the vane and the opening was about 1·5 mm., and the angular movement of vane was restricted by stops to about 30°. The motion of the vane was observed by reflecting a beam of light from the mirror *m* on to a scale at a distance of 80 cm.



The partitioned tube, together with the suspended vane, constitutes a Joule radiometer in which unequal heating of the columns of air in the two compartments will cause a deflection of the vane. The radiant heat from a candle flame at a distance of 2·5 metres falling on one side of the partition produced a deflection of 5 cm. of the spot of light on the scale. Owing to its high sensibility, it was found necessary to shield the columns of air from draughts and radiant heat from external sources.

A current of 6 amperes was passed through the thin copper wire *cd*, and a temperature gradient was thus established from the centre towards each end of the wire. The vane was deflected owing to the Thomson effects and the inequality of the Joule effects in the two halves of the wire. The position of the vane was fairly steady after an interval of five minutes, and the spot of light was brought to the centre of the scale by turning the bent wire *n* attached to the fibre. The current was rapidly reversed, and the spot of light moved quickly through 8 cm. on the scale. The wire *cd* was adjusted to slightly different positions in order to vary the inequality of the Joule effects, and practically the same result was found in every case. It was concluded from the direction of motion of the vane that in copper heat was absorbed when the current flowed up the temperature gradient.

To show the Peltier effect, an iron wire 4 cm. long and 1 mm. diameter was soldered to another pair of copper leads and bent just under the partition. The passage of a current of 1 ampere through the junctions was sufficient to move the spot of light off the scale. There is no need to reverse the current in this case, and it can be shown quite easily that heat is absorbed when the current flows from copper to iron.

F. W. JORDAN.

South-Western Polytechnic, Chelsea, S.W., May 8.

Compulsory Latin Diagnoses for Fossil Plants.

THE question whether descriptions of new species, genera, &c., of *fossil* plants should be accompanied in future by a diagnosis or diagnoses in *Latin* has been recently discussed among those who are working on fossil botany. It is not proposed here to enter into the arguments which have been advanced either for or against this proposition. It appears, however, that, so far as palæobotany is concerned, the arguments against the use of diagnoses in Latin are held far to outweigh those in favour of such diagnoses. In order to test current opinion on this point, a memorandum has been recently circulated by the writer among those who are engaged in the study of fossil plants in this country and in the United States, and by Prof. Nathorst in Sweden and Denmark. The object of the memorandum was to ascertain the present intentions of those working at fossil plants as regards this much disputed question. The result of this exchange of opinion has been very remarkable. Every palæobotanist in this country, in the United States, and in Scandinavia to whom a copy of the memorandum has been sent has expressed his intention of avoiding the general use of diagnoses in Latin, and, further, of recognising as valid diagnoses instituted in the future which are not published in Latin.

The memorandum in question contained two statements of intention, which were as follows:—

(1) "I do *not* propose to include a diagnosis in Latin in the description of any new species, genus or family that I may institute in the future, unless there appear to me, in particular cases, to be special reasons for so doing."

(2) "I will *not* refuse to accept new species, genera or families of fossil plants instituted by other workers in the future, solely on the ground that their description is not accompanied by a diagnosis in Latin."

The following is a list of those who have subscribed to both these statements. In the case of those names indicated by a *, some slight modification of the wording of one or other statement was made. These reservations follow the list of signatures:—

Mr. C. T. Bartholin, Copenhagen, Denmark.
Dr. M. J. Benson, Royal Holloway College, Englefield Green, Surrey.
Prof. E. W. Berry, Johns Hopkins University, Baltimore, U.S.A.
Prof. T. D. A. Cockerell, University of Colorado, Boulder, U.S.A.
Mr. W. T. Gordon, The University, Edinburgh.
Dr. Th. G. Halle, Stockholm, Sweden.
Dr. N. Hartz, Copenhagen, Denmark.
Dr. G. Hickling, The University, Manchester.
Mr. H. S. Holden, University College, Nottingham.
Mr. A. Hollick, New York Botanic Garden, New York, U.S.A.
Prof. E. C. Jeffrey, Harvard University, Cambridge, U.S.A.
Dr. R. Kidston, F.R.S., Stirling.
Dr. F. H. Knowlton, U.S. Geological Survey, Washington, U.S.A.
Mr. F. J. Lewis, The University, Liverpool.
Mr. A. J. Maslen, London.
Dr. H. Möller, Falun, Sweden.
Prof. A. G. Nathorst, Stockholm, Sweden.
Prof. F. W. Oliver, F.R.S., University College, London.
* Mr. Clement Reid, F.R.S., The Geological Survey, London.
* Mrs. Clement Reid, Milford-on-Sea, Hants.
Dr. D. H. Scott, F.R.S., Oakley, Hants.
Mrs. D. H. Scott, Oakley, Hants.
Dr. M. C. Stopes, The University, Manchester.
Mr. H. H. Thomas, The Botany School, Cambridge.
Mr. D. M. S. Watson, The University, Manchester.
Prof. F. E. Weiss, The University, Manchester.
Dr. D. White, U.S. Geological Survey, Washington, U.S.A.
Dr. G. R. Wieland, Yale Museum, New Haven, U.S.A.

Mr. and Mrs. Clement Reid have signed both statements with the addition of the words "if it is accompanied by a recognisable figure" at the close of the second statement after the words "diagnosis in Latin." They add

"we consider that the international character of the diagnosis will better be maintained if the Vienna rule be altered so as to read 'either a diagnosis in Latin *or a recognisable figure*.' This alternative would do away with the difficulty as to language, and would allow botanists to use their own language, provided they give a characteristic figure."

Prof. Seward has signed the second statement, and has added the following remarks:—"In view of the nature of much of the material available for investigation, I consider that it is undesirable to insist on a Latin diagnosis for all species described by palæobotanists. In cases where a formal diagnosis is possible, such diagnosis and a figure of the specimen ought to be given, but for the present at least I am not disposed to bind myself to the publication of a diagnosis in Latin. It is, I believe, in the interests of the subject to avoid pledging oneself to any fixed rule as regards either a diagnosis or the language in which the diagnosis is to be written.—A. C. Seward."

Prof. Zeiller, of Paris, to whom a copy of the memorandum was forwarded, has signed the second statement mentioned above, and has kindly expressed his reasons for being unable to subscribe to the first. These are as follows:—

"M'étant, au Congrès de Bruxelles, rallié, dans un esprit de conciliation, à la disposition générale qui fait de la diagnose latine une obligation, je n'en persiste pas moins à penser que cette obligation ne devrait pas être étendue à la paléobotanique, l'application s'en heurtant souvent, avec l'état fragmentaire et incomplet des fossiles végétaux, à des difficultés presque insurmontables, notamment lorsqu'il s'agit d'échantillons à structure conservée ne montrant que des caractères anatomiques internes.

"J'émets le vœu que tous les paléobotanistes s'unissent pour demander au prochain Congrès de leur laisser à cet égard la liberté dont ils avaient joui jusqu'ici, et à l'encontre de laquelle on n'a relevé aucun inconvénient.—R. Zeiller."

In conclusion, while, as we have seen, the British, American, and Scandinavian palæobotanists have agreed to avoid the *general* use of Latin diagnoses for the present, it should be pointed out that the object of the memorandum mentioned above has been solely to ascertain the opinions and *present* intentions of workers on fossil plants in this respect. It is, of course, understood that those who have subscribed to the two statements quoted above are not in any way bound as to the future, and they are at perfect liberty if, in altered circumstances in the future, they should wish to depart from their present opinions and intentions to do so. The view is widely held that perfect liberty in regard to matters of nomenclature, as in other directions, is essential to the progress of our knowledge of fossil plants.

E. A. Newell Arber.

The Sedgwick Museum, Cambridge.

Spitting Cobras.

The following note may be of interest, the more so as the existence of cobras in Borneo is denied in a recent work on Borneo ("Seventeen Years among the Sea Dyaks"). In your "Notes" in Nature of May 4 (p. 320) you refer to the "spitting cobras" of East Africa. The cobra of East Borneo also has the power of projecting its poison to a distance of at least 1 metre. In January of last year I was walking along a narrow jungle track about twenty miles from the coast, in lat. 1° 10′ S., when I saw a cobra erect preparing to strike at me. I struck it about 30 cm. from the head and broke its back (as I thought). It then projected two streams of liquid at me as I stood over it. A Bugis close beside me exclaimed, "dia menumpit!" (menumpit = to shoot with the blow-pipe). One stream struck the lapel of my coat, but I did not notice where the other struck. I placed the dead (?) cobra on a tree, intending on my return to carry it to my camp and bottle it, but when I returned it was gone.

About two hours after the incident I felt an irritation on my skin, which lasted for some hours, and then gradually disappeared. There was a newly healed leech wound at the place, but I could hardly believe that the cobra venom could have penetrated thick puttees, trousers, and socks all wet through. But I sent for the Bugis who had accompanied me, and without telling him anything, asked him to point out where the cobra poison had struck me. He immediately placed one finger on the lapel of my coat and another on my shin exactly where the irritation was.

He added that about ten miles away his brother had lost the use of his arm for three months because of a cobra which had projected its poison at him.

The cobra was black with a bluish sheen, but the throat was yellow. Estimated length, 1600 mm.

Boscombe, May 8. T. R. H. Garrett.

The Reform of the Calendar.

The article in this week's Nature on "Daylight and Darkness" leaves little to be said with regard to the so-called Daylight Saving Bill. Its adoption would indeed render us "the laughing-stock of the enlightened people of the world." No object, however good in itself, can be attained by a deceitful and underhand process, which must lead to many inconsistencies and misunderstandings. There is no reason why 12 o'clock should be the exact time of noon; in point of fact, it seldom is, as clocks must be regulated to keep *mean* time. But there is a very good reason, and it is of great importance, that the interval between two consecutive hours by the clock should be always exactly one hour. To regulate it otherwise would be deceitful and confusing.

My purpose, however, in this letter is rather with reference to Mr. Philip's letter on the "Reform of the Calendar." He denies that the week has had an unbroken continuance, because the paschal full moon on A.D. 31 (which he thinks was the year of the Crucifixion) fell on March 27, which was a Tuesday. Now the Jewish Passover had nothing to do with the day of the week, and might fall on any day, being regulated by the moon. That it fell in A.D. 31 on a Tuesday proves that that could not have been the year of the Crucifixion, which was probably A.D. 30, or possibly (as Prof. Sanday now thinks) A.D. 29. The seventh day of the week (the Jewish Sabbath) was the day after the Crucifixion, and the day after that, the first day of the week, the day of the Resurrection. Christians observed that day as their sacred day every week, and the Church decided (after the early Quartodeciman controversy, settled by the Council of Nicæa) to keep the Christian Passover (which we call Easter) always on that day of the week. There has, then, never been any break in the continuity of the week.

Blackheath, May 13. W. T. Lynn.

The Rusting of Iron.

In view of the correspondence which has taken place recently in Nature on this subject, I should like to refer to the results of some further investigations which I have made in conjunction with Mr. J. R. Hill in continuation of those published in the Journal of the Chemical Society in 1905. In that paper, and in other previous publications, experimental evidence was brought forward to show that the rusting of iron can take place in the absence of carbon dioxide, contrary to the generally accepted view. Several chemists have addressed themselves to the task of defending the old opinion that carbon dioxide is necessary. Their arguments were summarised recently in an article in Nature initialled "T. M. L." No exception can be taken to this article if its limitations are clearly recognised. It omits all reference to the large body of experimental work which has been published by Whitney, Tilden and others, in addition to myself, to show that the old view must be abandoned. The most recent work of Lambert and Thomson confirms this conclusion, whilst making an important addition to our knowledge of the conditions of reaction between iron, oxygen, and water when brought together in the most highly purified forms.

My object in writing this note is to state that I have now ascertained the cause of the inhibiting effect which certain substances, including alkalis and potassium bichromate, exert in preventing the rusting of iron, and it therefore becomes possible to explain a number of facts, including certain results which have been held to prove that carbon dioxide is a necessary factor in rusting.

It is now clear that all those agents which inhibit the rusting of iron (see Journ. Chem. Soc., 1905) also render the iron "passive" to a greater or less extent, and that this passivity of iron persists after the metal has been removed from the effective solution. Iron which has been immersed in alkalis or in a solution of potassium bichromate is found still to be passive after careful washing with water, that is, after removal of all trace of the solution which produced the effect. The iron is no longer attacked by nitric acid of a certain strength or by the appropriate solution of copper sulphate, nor does it "rust" in presence of oxygen and water. Contact with certain substances, especially dilute acids, including carbonic acid, at once destroys the passivity, and the iron becomes active again in all respects. A full account of this work and of its bearings will shortly be given.

The fact alluded to in recent correspondence, that an iron cylinder which has been immersed in potash solution and afterwards washed with water will not rust in air until carbon dioxide is admitted, does not prove that carbon dioxide is necessary for rusting. The observed facts are due, first, to the passivity of the iron induced by the alkali, and, secondly, to the destruction of this passivity by the carbon dioxide. The same piece of iron will rust freely in air deprived of carbon dioxide, provided that it has not been in contact with alkali of such a strength as will induce passivity.

May 9. WYNDHAM R. DUNSTAN.

SCIENCE AND THE IMPERIAL CONFERENCE.

SUCH words as Empire and Imperial, like many others, suffer some disadvantage from their historical antecedents. Looked at in the past they recall something Roman, something Napoleonic; the rule of dependent peoples, conquered by the sword, and governed, not wholly inefficiently, but without much say in the matter, by military power. Looked at in the present and with a scientific eye, the British Empire reveals itself as something fundamentally different. It is simply the last term of social aggregation. Free peoples, starting from the family, aggregate themselves into larger and larger groups, and the common freedom is maintained by the naval supremacy of the mother-country. The Crown consecrates the unity of the whole.

Every stage of aggregation in such a system has its common interests which require concerted action. The recognition of this inevitably leads to some sort of what Herbert Spencer would have called physiological integration in which the whole is greater, or at any rate more efficient, than the sum of its parts. The Imperial Conference, which is about to meet, has come into existence just as naturally as a municipality or a county council. The essential principle is the same: the scope of its deliberation will only extend to larger problems.

Such problems will be matters of high policy, and though it may be hoped that they will be dealt with in a scientific spirit, it is improbable that the direct interests of knowledge will for the moment find a place amongst them. But the principle of Imperial Conference, which happily there is every reason to regard as permanently established, has already received a development in a more detailed direction. The Imperial Education Conference, which held its last public sitting on April 28, has now received Government recognition, though its first meeting in 1907 was the result of unofficial initiative. It is not improbable that its example may be followed on behalf of other interests of no less importance.

Knowledge in a logical order would come before education. But the machinery of an Imperial Conference would probably not be very helpful to the progress of science in the abstract, as that cannot be earmarked to any nationality. The scientific study of the Empire itself is a field in which that machinery could find employment with results of the most profound scientific interest and the greatest practical utility.

Looking at the magnitude of the Empire, nothing is more remarkable than the feeble interest it excites in the mind of the average citizen. His horizon is rarely more than parochial, and the only imperial problem on which he probably has a distinct conviction is the necessity of maintaining our naval supremacy. It is something that in a vague way he should wish it to be maintained. But what the Empire is, or what are its future possibilities, he neither knows nor cares. In this he is hardly to be blamed. He was taught in his youth, as we may learn from the "Reminiscences of Goldwin Smith," that Colonies were a source of weakness, and we may learn from the same authority that half a century ago even the Colonial Office was animated with the idea of getting rid of them decently. If, since that day, opinion has changed to acquiescence in the existence of Empire, it is due to the influence and advantages of a peaceful commerce. Perhaps in generations to come it may excite a livelier enthusiasm.

A common attack, such as a conference might stimulate, on scientific problems, might do something to bring this about. There is no suggestion that science should be centred in the home-country. The dominions have their own scientific activity, and the ranks of the Royal Society are open to their workers. The problems that demand cooperation are not local but far extending, even cosmical.

Our Admiralty has charted the shores frequented by our shipping, and the world's navigation has the benefit. The international recognition of the meridian of Greenwich is our reward. But though the *Challenger* expedition made a noble beginning, a thorough exploration of ocean depths still remains to be accomplished, and is a task which naturally falls to a maritime race. But the land cries out to be accurately mapped. Both Africa and Australia have suffered from using imperfectly determined meridians of longitude as boundaries. The accurate determination of the position of salient points throughout the Empire would alone be a sufficient subject for a conference. Were this accomplished local surveys would start from a sound basis in filling up the details. As it is, even the survey of the United Kingdom is not absolutely coordinated with that of the continent. Such an enterprise as that of Sir David Gill in measuring an arc of the meridian from the Cape to the northern hemisphere would not be left to private initiative.

If the topography of vast territories is still imperfectly known, their geology is practically untouched. Africa differs from neighbouring continents in being all but an island. It seems to be the part of the earth's surface which has been least disturbed by volcanic action. It has preserved a structure of great antiquity. Thoroughly understood, it would throw light on an early chapter of the history of the earth.

In the southern hemisphere British maritime activity is dominant. A knowledge of the meteorology of its oceans is a necessary condition of their secure navigation. Sir Charles Bruce, in his "Broad Stone of Empire," has given a striking account of what has been accomplished towards it by the Mauritius Meteorological Observatory. Such a measure of undoubted success should stimulate further endeavour and the provision of other stations. It ought to be possible to predict the disastrous droughts of India

and Australia. This will never be accomplished until we thoroughly understand the influence of the Antarctic Continent. Its investigation would alone be a fit subject for an imperial conference. It is a problem which should no longer be nibbled at, but made the object of systematic attack.

If we turn from the physical to the biological field the need of cooperative endeavour is no less insistent. The problems of geographical distribution are hampered for want of material from large, uninvestigated areas. In anthropology our knowledge is still fragmentary, even of the subject races of the Empire. Commerce affords a wide area for the distribution of their local diseases. Cases of sleeping sickness are to be seen in our hospitals, and beri-beri has sometimes produced a panic in our ports. Yet the campaign against tropical disease has only begun.

If it is objected that such schemes are visionary, it may be replied that half a century ago they were actually within the field of practical politics, and that, too, at a time when anything like Imperialism was certainly not in fashion. In 1859 the Duke of Newcastle, the Secretary of State for the Colonies, wrote officially that "her Majesty's Government have under their consideration a project for collecting the materials of a National Work on the Astronomical features, the terrestrial physics, the botany, zoology, and geology of the Colonial Possessions of the British Empire." All this remained a project except as regards botany, which was imposed on Kew. The task, with various fortunes, sometimes of neglect and discouragement, has occupied it steadily ever since. With the completion, now in sight, of the two great Floras of Africa, under the editorship of Sir W. Thiselton-Dyer, the vast undertaking will have been practically accomplished. It is to be noted that except in the case of tropical Africa, the expense has been borne by the Dominions and Colonies concerned. And to the Flora of South Africa a spontaneous and not the least liberal contributor has been the Transvaal Government.

The inference that may be drawn from such facts is that while the Imperial Government could probably be induced to aid well-considered scientific work in the Crown Colonies and Protectorates, funds would be forthcoming for the share of that of the Dominions. Cooperation would give them a voice in the scope and character of any scheme, and a guarantee of its efficient and economical execution.

Such a sketch of what imperial cooperation might do for knowledge of the globe on which we live has at any rate the charm of a pleasant dream. Will it ever be realised? Not as long, certainly, as a Prime Minister can describe our Government as "the organised power of Philistines." The Philistine has the Government he deserves, and Philistine he will remain until the schoolmaster is touched with idealism and the aim of life ceases to be purely materialistic. Men may learn that though the pursuit of wealth may be exciting its attainment is dull in its results and usually mischievous in its effects. Ambition may prompt the rich to leave a worthier monument behind them than the mere record of their death duties. The value of wealth consists not in its possession but in its power, whether for good or evil. Perhaps the sporting instinct will come to the rescue of knowledge. Wealth may effect the performance of what a man may not be able to achieve himself, and yet feel some pleasure in seeing done. Money has been found to explore the ornithology of New Guinea, and men have been ready to risk their lives in the enterprise. Such sporadic efforts will never be wanting; what is needed is the coordination which will unite them in a considered campaign.

NATURAL HISTORY OF THE BIBLE.

THE celebration of the tercentenary of the English authorised version of the Bible is an event of national importance, when everything connected with Holy Writ commands, if possible, more than ordinary interest, not only from Biblical scholars, but also from a large section of the general public. Among the numerous sections of the subject, that which most commends itself to students of natural science is, of course, the natural history of the Bible in the wider sense of that term—that is to say, inclusive of zoology, botany, and mineralogy; and the present celebration affords a fit opportunity of reviewing and revising our knowledge of Bible animals, plants, and minerals, and also of considering whether any emendations of the names by which some of them are referred to in the authorised version ought not to be amended. This has been recognised by the authorities of the British Museum, who are now arranging in the hall of the Natural History Branch at South Kensington an exhibition of Bible animals, plants, and minerals, which will be opened in due course, and will doubtless attract a large amount of attention and interest on the part of the public.

Although comparatively little interest and importance attaches to the list of species regarded by the ancient Jews as unclean, the correct identification of the animals and plants referred to in other parts of the Bible is in many cases essential to a proper appreciation of the context, more especially when they are introduced to illustrate a simile, or to accentuate some striking or picturesque feature in local conditions. At the time when the authorised version was written natural history had scarcely attained the position of a science, even the birth of Linnæus not having taken place until nearly a century after the translators had finished their labours. But this lack of knowledge of natural history common to all educated persons of that day was by no means the only difficulty with which the translators had to contend. For, in the first place, the animals and plants of Syria and Palestine were probably even less known than those of several other parts of the world; while, secondly, the dispersal of the Jews had led to the proper meaning of many of the old Hebrew names of animals and plants being more or less completely forgotten.

Consequently the translators were plunged into a very sea of difficulties, from which, considering all things, it is little short of a marvel that, despite many egregious blunders, they emerged as creditably as they did. In regard to names of which the true signification was not apparent the translators followed two distinct courses. In some cases, as, for instance, with *shâphân* ("the hider"), they made a "shot" at the meaning of the name, rendering the one quoted by coney, the then current designation of the rodent we now term (except in legal phraseology) rabbit. On the other hand, some Hebrew names, like *shittim* and *almug*, among the designations of timber and trees, were transferred directly to the English version without any attempt at translation or identification. And there is little doubt that this latter was the preferable course. Indeed, in the case of almug trees it is almost the only legitimate one, as the species is not yet identified with absolute certainty, although it may be the red sandal-wood of India. Shittim-wood might, of course, be now translated as acacia, but even this would be unsatisfactory, as the tree popularly known in this country by the latter name is really a Robinia.

In a few instances, as in the case of "pygarg" for *dishon*, the translators used terms of which they could not possibly have known the proper meaning;

the African antelope termed *πύγαργος* by Herodotus being still unidentified, and therefore having no claim to be regarded as the equivalent of the Hebrew *dishon*.

The real misfortune is, however, when well-known English names of plants and animals are given as the equivalents of Hebrew words of totally different signification. Examples of this are apple for apricot, chestnut for plane, sycomore or sycamore (etymologically justifiable) for a fig of the banyan group, ferret for an animal which may have been a gecko, the aforesaid coney for the Syrian hyrax, and, above all, badger (in the shape of badgers' skins) for the Red Sea dugong. The last is indeed a particularly bad case, as it should have been obvious that badgers' skins, even in a comparatively dry climate, do not form suitable material for a church-roof. The case of "coney" has been complicated by the word having fallen practically into disuse, in the original sense, in consequence of which many persons, and especially Americans, appear to regard it as the proper English name of the hyrax.

In nearly all the cases where the real meaning of the original cannot be ascertained, or where, as in the instance of sycomore, we have no vernacular name for the species referred to, it appears to me that it would be much better if the Hebrew word were retained, with a brief marginal explanation.

In modern times much light has been thrown on Bible natural history by identifying the old Hebrew names of animals and plants with their apparent equivalents in Arabic and Coptic, and likewise by the study of the animals represented in the Assyrian and other ancient sculptures, as well as in the Egyptian frescoes. The mummified animals of Egypt have also contributed their quota of information. There is, however, little doubt that if further attention were devoted to the correct identification of the animals in the magnificent series of Assyrian and Babylonian sculptures in the British Museum still more information might be obtained.

In our own country the great pioneer in this line of research was the late Canon Tristram, whose "Natural History of the Bible" and "Fauna and Flora of Palestine" still remain standard authorities. To Tristram we owe the identification of the Hebrew *reem*, mistranslated unicorn in the authorised version, with the extinct wild ox, or aurochs, the name apparently still surviving in the Arabic *rim*, now applied in North Africa to certain large gazelles. And in his works will be found mention of the identity of the Hebrew *nesher* (translated eagle) with the Arabic name, *nisr*, of the griffon vulture; of the Hebrew *cabh* (rendered tortoise) with *dab*, the Arabic term for the lizards of the genus Uromastix, and many other analogous instances. Unfortunately, Tristram was led to believe that several kinds of large North African antelopes, such as the bubal hartebeest, the addax, and the white or sabre-horned oryx, were natives of Palestine and the adjacent regions, whereas it is now ascertained that none of these ranges to the east of the Lower Nile, although the white oryx was brought down from the interior by the ancient Egyptians. Consequently his identifications of Bible ruminants are to a great extent erroneous, but an attempt has been made to correct them in the new edition of "Murray's Dictionary of the Bible." Important information, especially in regard to insects, will also be found in the "Oxford Bible." On the Continent, Dr. Duerst, in various publications, has contributed largely to our knowledge of the cattle—wild and tame—of Biblical times, while Dr. Lortet and his associates, whose studies of their mummified remains are published in the Archives of the Lyons Museum, have done the same for the sheep, goats, dogs, &c.

To attempt anything like a complete survey of Biblical natural history in the space at my disposal is obviously impossible, and references can only be made to a few points of general interest. Whatever may have been the origin of the story of Jonah, it is curious to note that in the Ethiopic Bible the whale is referred to as *anber*, the Arabic equivalent of ambergris, and was thus evidently regarded as the sperm-whale, by which alone that perfume is produced. Here my readers may be reminded that ambergris was the original amber, the latter word having been subsequently transferred to the substance now known by that name. Although leviathan in one passage seems undoubtedly to indicate a whale, it generally refers to the Egyptian crocodile, the range of which, until recently at any rate, extended to Syria, and formerly, as attested by the story of St. George and the dragon, included Asia Minor.

The above usage of one and the same Hebrew word in two senses is not unparalleled in the Bible, and must have been another sore difficulty in the path of the translators. *Tinshemeth*, for instance, which is translated in one passage as mole and in others as swan, is considered to indicate the chamæleon in Leviticus xi. 30, while in another part of the same book it is believed to stand for some kind of aquatic bird, which may perhaps have been the purple water-hen. Before leaving *tinshemeth*, it may be added that not only were the translators wrong when they rendered it mole, but that they were also in error when they identified another Hebrew word, *hephor-perôth*, with that animal; for, as a matter of fact, there are no moles in Palestine and Syria, and the burrowing animal indicated would seem to be one of the rodent mole-rats of the genus Spalax.

In the rendering of the names of birds, the translators were in several instances either exactly or approximately correct, pelican, crane, stork, quail, and partridge being exact translations, while glede (an old name of the kite) and hawk are near enough approximations for the smaller birds of prey, as is also swallow for swift. It is curious, however, that in two passages where swallow and crane are mentioned together, the latter name is employed as the translation of the Hebrew word meaning swallow (or rather swift), and *vice versâ*. Sparrow, the translation of *tzippor*="the chirper," is doubtless used in a general sense, although, as Tristram pointed out the solitary sparrow on the housetop is in all probability the blue rock-thrush. Possibly such names as "gier-eagle" (from the German *gier*, a vulture, and familiar in the form of lammergier) and "ossifrage" may have been in use in this country in the seventeenth century, but nowadays neither conveys any definite meaning to the reader, the former really indicating the Egyptian scavenger-vulture, or "Pharaoh's hen," and the latter the lammergier. Lapwing is distinctly an unfortunate translation, the bird indicated being probably the hoopoe.

In regard to invertebrates, it may be noted that the rendering of *sās* in Isaiah as worm is not far out, as the word indicates the larva of a clothes-moth, and it has been suggested to me that the "booth that the keeper maketh" (Job xxvii. 18) refers to the rough larval case of a psychid moth. "Cankerworm" is now generally admitted to refer to one of the immature stages of the locust, and in the Oxford Bible it is suggested that "palmer-worm" may include not only caterpillars, but likewise a second immature phase of the locust, which would accord well with the context. Locust, grasshopper, ant hornet, bee, fly, flea, and scorpion are correct, or

nearly correct, renderings of the Hebrew names for which they stand; and the same is doubtless the case with coral, which is found in the Red Sea and the Persian Gulf. Pearls in the Old Testament is, however, the rendering of the Hebrew *gābhîsh*, signifying ice and thus rock-crystal, whereas in the New Testament *μαργαρῖται* is rightly translated pearls. Manna, it is perhaps needless to add, was certainly not the product of a Coccus, as the natives of Palestine now tell travellers, but apparently a mountain lichen, of which quantities were at times blown down to the plains.

A few allusions to botany have been already made, and it may be added that in the case of cultivated plants many of the translations are more or less nearly true to nature. A "garden of cucumbers," for instance, conveys an excellent idea of the abundance of melons, gourds, cucumbers, &c., characteristic of so many Eastern countries; but a local touch of colour is unfortunately lost in the reference to "white, green, and blue hangings," in which the word rendered "green" should have been translated "cotton," so that the passage should run "where were hangings of white and violet-coloured cotton." Lack of space prevents me, I regret to say, saying more on this part of my theme, and the same limitation prevents a discussion on minerals. This, however, is not a matter for regret, as Dr. Fletcher informs me that the whole subject is in great confusion, and it will therefore be advisable to await his contribution to the forthcoming exhibit at the Natural History Museum. It may be mentioned, however, that in many cases at any rate the precious stones referred to in the Bible are rightly identified only so far as the matter of colour is concerned, sapphire being apparently lapis lazuli, ruby an unknown red stone, chrysolite probably a topax, and chrysoprasus a green chalcedony akin to the "prase" from which Egyptian scarabs were cut.

I should have liked to say something with regard to the animals of the New Testament, but can only refer to Prof. Ridgeway's identification of the "pale horse" (*ἵππος χλωρός*) of Revelation with the dun breed, or the one of the colour of dry grass. Naturally one would have expected to find the black horse associated with Death; but, according to Prof. Ridgeway, the dun was regarded as the worst breed, and accordingly despised, a fact which, it may be suggested, perhaps affords another argument in favour of the antiquity of this type.

R. L.

MEDITERRANEAN CIVILISATION AND THE PHAESTOS RIDDLE.[1]

JUDGED by the declared aims of the author, who before his lamented death, was one of the brightest of Italian men of science, this is an eminently successful work. He is "convinced that it is worth while to excite the curiosity of those who are not archæologists," and he never forgets the average reader. He is equally convinced of the independence of Mediterranean civilisation, and he has undoubtedly made out a very strong case. The author's enthusiasm sometimes makes the reader unnecessarily suspicious, but added to the popularising and argumentative motives of the author is a sincere respect for facts, and the wants of the specialist are also provided for in numberless references and footnotes. The author was himself an experienced explorer, and he has some interesting theories of his own to put forth, such as that Cyprus is not "the land of copper" and that the word *bronze* is a form of Brindisi (p. 208). On Minoan matters he writes from first-hand knowledge. In Italy he did excellent work in completing a survey of the known dolmens of that country. The dolmens illustrated are remarkably similar to our British cromlechs. The book is

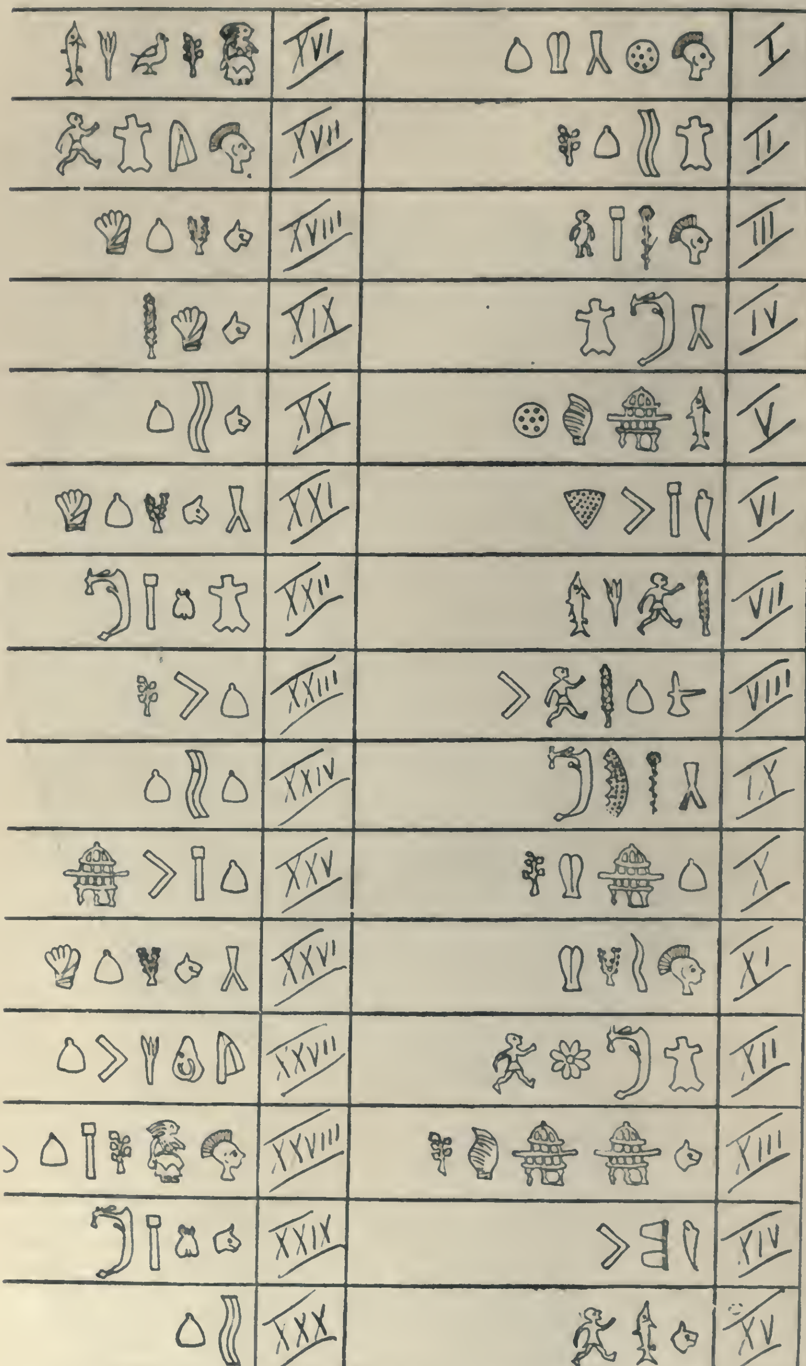
Face A.

FIG. 1.—Disk, with Hieroglyphic Inscription, from Phæstos. From "The Dawn of Mediterranean Civilisation."

[1] "The Dawn of Mediterranean Civilisation." By A. Mosso, translated by M. C. Harrison. Pp. xxiii+424. (London: T. Fisher Unwin, 1910.) Price 16s. net.

very usefully illustrated, and the translator's work is excellently done.

On one important point the author gives the average reader more than the latter might expect. He takes us into the laboratory, with the usual result of making us a little uncomfortable. I refer especially to a section entitled "Dr. Evans's Chronology" (pp. 98–102). We have lately been in the habit of accepting without hardly a question the opinions expressed by experienced explorers respecting periods and stages of culture based on the depth and stratification of deposits. The author's remarks on this point are so important and disconcerting that his conclusion as regards the deposits at Phæstos should be cited here in full.



Face B.

FIG. 2.—Transcription of the Inscription on the Phæstos Disk. From "The Dawn of Mediterranean Civilisation."

"Dr. Mackensie has already expressed a doubt that a stratum may be missing at the end of the neolithic period in the soil of Knossos. My own conclusion would be to fix the duration of the neolithic occupation of Phæstos at about 2500 years, while for a complete estimate of the whole period up to the Christian era—the depth of neolithic strata in a pit at Knossos being seen to exceed 8 metres—Dr. Evans being of opinion that at a moderate estimate a period of 14,000 years from the first neolithic stratum at Knossos must be reckoned, in my opinion it should be estimated at not more than 7000 years, or possibly less.

"With every respect for the great authority of Dr. Evans, I should give a provisional character to these critical remarks until the doubtful points I have alluded to are cleared up. The chronological computation of the rapidity with which the level of the soil rises on sites of human habitation in the neolithic age and during later periods is a complex problem which depends on coefficients which are not constant, but variable. I am convinced that in the case of Knossos the quota of 1 metre for every 1000 years, as fixed by Dr. Evans, is too small" (pp. 101–2).

It is passing strange that an explorer with such a deep conviction of the variability of archæological coefficients has never a word to say of the results of a search for constant coefficients in astronomical data. Surely one-half of the archæological world knows nothing of the other half: at any rate, one would rather risk such a reckless statement than to suggest that such a fair-minded critic of archæological methods should, for no conceivable reason suppress any evidence whatever. Any suppression of the kind would only intensify a retributive reaction.

Here in Britain astronomical archæology is now so much in evidence that every archæologist seems to have formed a definite opinion of its worth. The majority, perhaps, would prefer pointing out its worthlessness, but it happens that a majority in such a case might mean next to nothing, especially as I have not yet seen any demonstration of the worthlessness of the astronomical method involving sufficient technical knowledge to use the method itself. Round condemnatory statements

of that method have been made by some of the authorities whose own criteria are criticised by our author. Behold, now, the day of retribution!

The author gives a useful general account of the important find made by Dr. Pernier, of the Italian Archæological Mission, at Phæstos, Crete, in 1908. It was a clay disk inscribed on both sides with lines and pictographs. Judged by such standards as the author himself questions, the inscription is supposed to belong to the eighteenth century B.C. The authorities cited are very much divided as to what the inscription is and the affinities of the strange characters with known forms. Not one of those cited seems to have gone so far as Prof. Hempl, in *Harper's Magazine* for January, and Miss Stawell, in the *Burlington Magazine* for April, as to attempt a more or less complete interpretation.

In neither of the interpretations referred to is the possible calendric character of the document taken into consideration, and as I think it is a calendar, the opportunity for reproducing our author's illustrations of the document is my excuse for appending a brief outline of my findings.

In form the calendar is a rough copy of the use made of concentric circles. The pictographs on face A number 123, and not 122, as stated by our author; those on face B number 119. Each pictograph represents one degree of angular distance, and it is to be multiplied by three to make up the number of days in a year. Year A was $123 \times 3 = 369$ days, which on evidence given by Mommsen was once the length of a Roman year. Year B was $119 \times 3 = 357$ days. Assuming such a rotation as A B A, the sun would have travelled 365 pictographs or degrees in three years of the average length of 365 days. If the exact *locale* of the calendar were certainly known, its date might be made out by means of established formulæ. Its physical basis was a latitude where the apparent distance between the solstices was about 60° 50′. Of that figure I am fairly sure, and it would have roughly suited Crete in 1800 B.C. The latitude of Phæstos on an Admiralty chart is 35° 25′ N. It is much doubted, however, that the disk originally belonged to Phæstos, so that any calculation on the basis I have suggested would not materially help in fixing a date.

The calendar is quite complete, and a marvellous compendium of calendric contrivances. It is all based on the intersolstitial distance, expressed in integers, and divided by 3, 7, 17, and other numbers, an artificial system, it is true, but a very convenient one. The calendric significance of many of the pictographs stands clearly revealed when the numbers are noted. Some of them are very curious rebuses, a proof of considerable antiquity. For instance, the pagoda-like structure I felt sure stood for the number 20 in degrees and 60 in days, but for many a day I could not see either number in it. It is a four-storey building, the beams of each section numbering 5; hence $5 \times 4 = 20$, and $15 \times 4 = 60$. It indicates a legislative assembly, corresponding in significance and dates to the Tiocobrextio of the Coligny Calendar, and the entries under March 24 and May 24 in the Roman Calendar.

In all I have said so far there is hardly an element of speculation, and none of the ingenuity shown in such interpretations as those referred to. There is a precedent and an established formula to aid the inquiry at every step. A complete astronomical interpretation of the calendar will strike all students of our monuments, astronomically considered, as something quite familiar, while a sufficient scope will be left for authorities on ancient scripts to do all they can to determine the linguistic values of the pictographs, a subject I can hardly touch.

JOHN GRIFFITH.

MILITARY AVIATION AT HENDON.

THE demonstration of flying organised by the Parliamentary Aerial Committee, which took place on Friday last at Hendon, cannot be described as other than an unqualified success. If experts learnt no new lesson, if aviators acquired no new experience, the onlookers, including almost all those whose opinions would be sought and whose dicta may become law, must have had their eyes opened to the great possibilities as to the utility of the aeroplane in war.

A number of different types of machine, Farmans, Blériots, Cody, Roe, and Valkyrie were to be seen, and their respective merits compared. Besides exhibitions of rising quickly from the ground, descending near a given spot, turning and planing in the air, all of which were carried out in a superb manner, there were many tests having reference to warlike operations. A number of small dummy bombs were dropped from different machines on to ground marked out to represent the deck of a battleship. The idea was to test the possibility of attack by such means, but, although many good shots were made by dropping the missiles while travelling at a speed of perhaps 40 miles an hour, yet most of them were made from a height of only a few hundred feet, whereas to be of use in war they should be discharged from machines at least 2000 or 3000 feet above the ship. However, it is evident that if good shooting can be made in this way, it is only a matter of judgment and practice to be able to achieve good results at a much greater range. Another purpose to which such a method of attack is applicable is that of destroying dirigible balloons, and in such case the aeroplane might well be within a hundred feet of the target below it.

A more important experiment was that of discharging heavy weights, said to be 100 lb., from a flying biplane. It seemed probable that this might affect the balance of the machine, and cause it to pitch or jump, but careful observation showed that the aeroplane maintained a perfectly steady course, and was unaffected by the sudden loss of this load.

But the finest display, and perhaps the most practical experiment, so far as the immediate use of aeroplanes is concerned, was that of sending off a dispatch to a distance. Mr. Hamel went off on a Blériot monoplane to Aldershot, a distance of 32 miles "as the crow flies," though, as a matter of fact, the aviator went in a not perfectly straight line, in order to pick up familiar landmarks, and so make sure of his way.

Having handed in the dispatches at Aldershot, he returned with the reply, and it was a very impressive sight for those at Hendon to descry, high up in the sky, to the south-west, a small speck, estimated at 4,000 feet, which gradually approached and became recognisable as the monoplane, which, sweeping round a large circle, glided downwards and landed within a few feet of the starting-point. The message had been delivered and returned within two hours, the actual times being:—

Left Hendon	3.35
Arrived Aldershot	4.20
Left ,, ...	5.0
Arrived Hendon	5.35

Other events were the ascents of two staff officers on biplanes piloted by experienced aviators, who, without any previous experience, were to report on the position of certain troops which had been posted in the neighbourhood. This was most successfully accomplished. Short trips made by Mr. Balfour and by Mr. McKenna, First Lord of the Admiralty, tend

to bring home to the public the ease and safety of aeroplane travel.

One important item of the programme was not carried out. It was announced that if the circumstances were favourable the Army dirigible "Beta" would come up from Aldershot and take part in the proceedings. The weather proved perfect, it being almost a dead calm with bright sunshine. The "Beta" was ready and actually made one ascent, but for some reason which has not been given out she did not attempt the journey. Advocates of the aeroplane as being a more practical apparatus than the dirigible claim this as a triumph for their cause.

B. BADEN-POWELL.

SPORT AND TRAVEL IN CENTRAL ASIA.[1]

THIS book, as its writer says, is merely "a plain record of a year's wanderings in the lesser known parts of Central Asia for the purpose of sport and travel." Its author had eyes for little else than the quest of large game for the sake of their heads as trophies. Of the country through which he passed or of its people, he tells us little, and nothing at all of its other fauna or its flora, and of many of the topics of human and scientific interest which the general reader expects to find in travel-books of little-known regions. Even in regard to the large game themselves the bald narrative provides no new facts nor any intimate study of the animals or their haunts. The photographs of the heads, however, are of some interest, as the specimens hitherto figured are not numerous and the limits of several of the species are not yet clearly defined. The account of the camp outfit also may supply some useful hints to sportsmen who contemplate an excursion in those regions.

Ovis Karelini. From "Across the Roof of the World."

Starting from Kashmir, the author crossed the Pamirs by the usual route, shooting on the way an *Ovis poli*, the horns of which measured (doubtless along their inner curve, as usual) "under 50 inches"; but he saw a pair on a tomb at Kashgar which were 72 inches. Beyond Turkestan, in the Thian Shan, he shot two specimens of the great stag generally termed the "Asiatic Wapiti" (*Cervus canadensis songdricus*), locally known as "Boga" by the Mongols, with horns measuring respectively 48 and 49 inches, the latter pair carrying 14 points or tines. A specimen of the *Ovis karelini*, with horns "just over 40 inches," was shot there, also the Turkestan ibex, with a horn length of 55 inches—the record being 57½ inches—and several Siberian roedeer (*Capreolus pygargus*). It is rather surprising to read that the skins were merely rubbed with crude wood ashes as a preservative and nothing else. Continuing northwards through Dsungaria, Lieut. Etherton sighted, on the plain of Lake Ebi, what he believed were wild horses (*Equus prejevalski*). The Altai was crossed in mid-winter, too late to attempt following the *Ovis ammon*, for which that range is famous, so our traveller turned down the steppes of the Irtish and Obi valleys to the Trans-Siberian Railway near Tomsk, where civilisation was reached once more.

[1] "Across the Roof of the World."—A Record of Sport and Travel through Kashmir, Gilgit, Hunza, the Pamirs, Chinese Turkistan, Mongolia and Siberia. By Lieut. P. T. Etherton. Pp. xvi+437. (London: Constable and Co., Ltd., 1911). Price 16s. net.

NOTES.

IN consequence of the Whitsuntide holidays, the annual visitation of the Board of Visitors to the Royal Observatory, Greenwich, will take place on Friday, June 2, instead of on Saturday, June 3.

THE newly erected Cancer Research Institute at the Cancer Hospital is to be opened by H.R.H. the Duke of Connaught on Tuesday next, May 23, at 3 o'clock.

AN earthquake shock was felt at 8.50 a.m. on Tuesday last in the Ullswater Valley.

WE regret to learn from a Reuter telegram that Prof. Ernst Haeckel met with a serious accident on Tuesday. In endeavouring to reach a book from a high shelf he fell, breaking his hip bone.

WE regret to notice the death, at the age of eighty-two years, of Sir Nathan Bodington, Vice-Chancellor of the University of Leeds.

THE death is announced, at the age of sixty-five years, of Mr. Emerson M. Bainbridge, well known for his work in connection with coal-mining. In 1867 he was selected to report to the North of England Institute of Mining Engineers on the haulage of coal, and received for his services a valuable premium. Two years afterwards the Institution of Civil Engineers awarded him the Manby premium for a paper upon the probability of working coal at a depth of 4000 feet. Another paper, on the prevention of colliery explosions, was rewarded by the conferment of one of the Herman prizes. Mr. Bainbridge was a member of the Royal Commission on Coal Dust in Mines in 1891, and a juror of the Inventions Exhibition of 1883.

IT is announced in the *Revue scientifique* that a committee has been formed for the purpose of erecting a monument to the late M. Bernard Brunhes, who died last May at the age of forty-two years. M. Brunhes was for ten years director of the observatory at Puy-de-Dôme.

A MEETING of the Society of Tropical Medicine and Hygiene will be held at 11 Chandos Street, Cavendish Square, to-morrow—Friday—evening, when a discussion on the present position of the prophylaxis of malaria by quinine will be opened by Dr. W. Carnegie Brown, and a paper on the nature of Zambezi fever, by Dr. W. I. Bruce, of Chinde, and a note on cultural characteristics of a variety of the streptothrix of white mycetoma, by Dr. N. F. Surveyor, of Bombay, will be presented.

THE 129th Harveian Festival of the Royal College of Physicians of Edinburgh is to be held to-morrow, May 19, when Sir Alexander R. Simpson will deliver an oration on "Life and its Epiphanies."

THE Faraday Society has organised a general discussion on high temperatures, to be held on Tuesday, May 23, at the Institution of Electrical Engineers, Victoria Embankment, W.C. The following programme has been arranged:—Dr. Arthur L. Day will read a paper on recent advances in gas thermometry; Dr. J. A. Harker, F.R.S., will describe the high-temperature equipment at the National Physical Laboratory; Mr. H. C. Greenwood will read a note on boiling points of metals; and Mr. A. Blackie will speak on the behaviour of silica at high temperatures. Contribution to the discussion have been promised by Prof. Bodenstein on the maintenance of constant high temperatures, M. Féry on stellar pyrometry, and others. Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, will preside. During the afternoon the society, by the invitation of the director, will visit the National Physical Laboratory to inspect the high-temperature equipment of the laboratory.

DR. HENRY HEAD, F.R.S., will deliver the Croonian lectures (upon "Sensory Changes from Lesions of the Brain") before the Royal College of Physicians of London on June 13, 15, 20, and 27.

AT the convention of the Incorporated Municipal Electrical Association, which is to take place at Brighton and at Portsmouth on June 27 to 30, the following papers are to be read and discussed:—electricity supply viewed from the municipal committee's standpoint, by Councillor H. Leese; modern wiring practice, by Mr. J. W. Beauchamp; internal-combustion engines in power stations, by Messrs. H. L. Howard and R. M. Carr. There will also be discussions on purchase of fuel and street and shop-front lighting, opened, respectively, by Mr. C. E. C. Shawfield and Mr. A. H. Seabrook.

THE annual general meeting of the Society of Chemical Industry is to be held in Sheffield on July 12. Dr. R. Messel has been nominated as president, and Sir William Crookes, F.R.S., Dr. G. G. Henderson, and Messrs. H. Hemingway and W. F. Reid have been nominated as vice-presidents.

THE ninety-fourth annual meeting of the Société Helvétique des Sciences Naturelles will be held this year at Soleure from July 30 to August 2. The first general meeting will take place on July 31, when the president for the year, Dr. A. Pfaehler, will give his opening address, and the following lectures will be delivered:—M. Georges Claude, on "La Liquéfaction de l'air, son état actuel et ses applications"; Prof. Ursprung, of Freiburg, on "Der heutige Stand des Saftsteigungsproblems"; Dr. H. Stauffacher, of Frauenfeld, on "Die Rolle des Nucleins bei der Fortpflanzung"; and Prof. Otto Schlaginhaufen, of Zurich, on "Reisen und Forschungen in Melanesien." The second general meeting will be on August 2, for which the following lectures have been arranged:—Prof. Abderhalden, of Berlin, on "Neuere Anschauungen über den Zellstoffwechsel"; Prof. P. Gruner, of Berne, on "Die neueren Vorstellungen über das Wesen der Elektrizität"; and Dr. Albert Brun, of Geneva, on "Les recherches modernes sur l'exhalaison volcanique." The annual meetings of the Swiss societies of botany, chemistry, geology, mathematics, physics and zoology will be held also at Soleure on August 1.

A COLLIERY and General Mining Exhibition, lasting a fortnight, was opened in Manchester on Friday last by Prof. Sir Thomas Holland, K.C.I.E., F.R.S., who in the course of his remarks said the exhibition contained methods for securing safety underground and rescue apparatus for saving life after accidents had occurred. The improved methods of machines on view had an important bearing on the economy of mining, and thus the exhibition would be of service in showing how our natural resources could be turned to full account. He reminded his hearers that large quantities of coal were destroyed in the process of mining it, and that every ounce of coal ore or mineral that was destroyed was destroyed once for all without possibility of replacement. He suggested that, if the colliery owners of Lancashire would get together in groups and employ young geologists to correlate the information that was available, a geological map of the district might be constructed the practical usefulness of which would repay its cost many times over.

THE first International Chemical Engineering and Industries Exhibition was opened on Saturday last at the Royal Agricultural Hall, Islington, by Lord Denbigh.

DR. E. J. RUSSELL, of the Lawes Agricultural Trust, having directed attention to the need and value of photographs illustrating the scenery associated with various geological formations, the Tunbridge Wells Natural History Society is offering for this purpose a series of prizes, of 2*l*. each, for the best set in the following subjects:—first, scenery of the chalk districts—hills, sections, valleys and combes; second, scenery of the Wealden sandstone formation—sections, &c.; third, scenery of the Tertiary beds; fourth, scenery connected with shingle, gravel or sand beds; fifth, river and marsh scenery. Messrs. W. Whitaker, F.R.S., and R. Child-Bayley, editor of *Photography and Focus*, have kindly promised to act as judges. Full details of the competition can be had on application (stamp should be enclosed) to Mr. Geo. Abbott, 2 Rusthall Park, Tunbridge Wells, and the prints should be sent to him on or before March 1, 1912.

ACCORDING to *The Athenaeum*, an expedition to south-east Arabia has been planned by the Danish Royal Geographical Society, the object being the mapping of parts of Oman and the studying of the ancient memorials and commercial prospects of the country.

THE Research Committee of the National Geographic Society of Washington has made an appropriation of 5000 dollars for continuing the glacier studies of the two previous years in Alaska. The work, beginning in June, will be done by Prof. R. S. Tarr, of Cornell University, and Prof. Lawrence Martin, of the University of Wisconsin, who have directed the National Geographic

Society's Alaskan Expeditions of 1909 and 1910 in the Yakutat Bay, Prince William Sound, and lower Copper River regions. The 1911 expedition will study briefly a number of regions of glaciers not previously investigated by the National Geographic Society, although partially mapped by the Alaska Division of the U.S. Geological Survey, the Boundary Commissions, &c. Work will be done on the present ice tongues and the results of glaciation in the mountains and plateaus of parts of the interior and some of the fiords of south-eastern Alaska, the former having lighter rainfall and smaller ice tongues than the Yakutat Bay and Prince William Sound regions.

To *Naturwissenschaftliche Wochenschrift* of April 30 Prof. Branca communicates a popular notice of the dinosaurian remains obtained from the Lower Cretaceous of the Tendaguru Mountains of German East Africa by the recent expedition from Berlin. The most noteworthy feature of these remains, so far as they have been examined, appears to be their gigantic dimensions, which largely exceed those of Diplodocus. The longest rib of the latter measures, for instance, 1·86 m., whereas some of the African ribs are no fewer than 2·50 m. in length. Again, the longest cervical vertebra of the former is 0·64 m., in contrast to which is one from Tendaguru—possibly not the biggest—measuring 2·10 m., while a humerus of the African dinosaur is $2\frac{1}{4}$ times as long as the corresponding bone of Diplodocus, measuring 2·10 m. (6 feet 10 inches) against 0·95 m. (3 feet 1 inch). It should, however, be borne in mind, although this is not mentioned by the author, that Diplodocus is not the largest known reptile, its femur measuring 1·542 m., or 5 feet $1\frac{3}{4}$ inches, against 6 feet 2 inches in that of Atlantosaurus. Still, as the femur is always a much longer bone than the humerus, the advantage is largely on the side of the African reptile. According to the author, the remains previously obtained from East Africa by Dr. Fraas were much larger than those of any other known dinosaur, but these are completely eclipsed by the new specimens. In addition to the dinosaurs, remains apparently referable to pterodactyles have been obtained. Remains have likewise been discovered in several other localities of German East Africa. Prof. Branca adds some remarks in regard to the pose and food of the sauropod dinosaurs, observing that if these reptiles subsisted on a vegetable diet, it is difficult to imagine how they obtained sufficient nutriment. The same difficulty, it may be mentioned, has occurred to another naturalist, Mr. J. Versluys, who has suggested in the *Zool. Jahrb., Abtheil. f. Systemát.*, vol. xxix., p. 425, 1910, that these reptiles fed on fishes. Prof. Branca is also exercised in his mind how the sauropods obtained sufficient calcareous matter for their enormous skeletons; but it may be pointed out that the supply of this substance would increase *pari passu* with the amount of food consumed. In this connection, it may be noted that *The Scientific American* of April 8 contains an illustrated account of the life-sized restorations of dinosaurs recently installed by Mr. Carl Hagenbeck in his Tiergarten at Stellingen, near Hamburg.

MR. L. L. WOODRUFF has contributed to the *Archiv für Protistenkunde* (vol. xxi., 1911) a remarkably interesting account of the results which he has obtained in breeding experiments with Paramœcium. Of late years there has been a tendency amongst biologists to accept the view that the multiplication of unicellular organisms by simple fission cannot go on indefinitely, but leads ultimately to exhaustion and even extinction of the family unless the failing vitality be renewed by conjugation. According to Mr. Woodruff, this only holds true when the organisms are exposed to a more or less constant environment. He finds that by subjecting the Infusoria to a varied environment (represented in this case by the culture medium), they can be made to keep on dividing indefinitely in a perfectly normal manner without conjugation or the use of artificial stimulation. The culture on which this conclusion is based has been kept under observation for nearly three and a half years, during which time over two thousand generations of Paramœcium have been produced, giving an average of about one division every fifteen hours.

IN the March issue of *The National Geographic Magazine* Messrs. Collins and Doyle, of the U.S. Department of Agriculture, describe a tour in southern Mexico undertaken with the object of investigating the causes of the immunity of the crop in that region from the destructive cotton-boll weevil. The results are not quite conclusive, but it appears that in some districts the practice of planting the cotton crop only in alternate years is a successful method of combating the weevil, and that in other places the boll is found to be naturally protected against its attacks by the abnormal growth of proliferating tissue, or in some cases that the aperture by which the weevil enters the boll was sealed up by the growth of the web of a small jumping spider (*Aysha minuta*).

AN interesting article on the plant knowledge that prevailed formerly among the Gosiute Indians is communicated by Mr. R. V. Chamberlin in the Proceedings of the Academy of Natural Sciences of Philadelphia (February). The tribe inhabited the desert region lying to the southwest of the Great Salt Lake in the State of Utah, but nevertheless made very extensive use of plant products for food and medicine. Green vegetables were prepared from the leaves of the composite *Balsamorhiza sagittata* and the umbellifer *Cymopterus montanus*. The tuberous roots of *Carum Gairdneri* were much esteemed, also the bulbs of *Calochortus Nuttalli*. Seeds were gathered from *Salicornia herbacea*, species of Atriplex and Chenopodium, *Sisymbrium canescens*, various composites, *Triglochin maritimum* and *Typha latifolia*; while the "nuts" of *Pinus monophylla*, formerly of necessitous importance, are still collected in quantity. Pharmaceutical remedies were prepared from the roots of *Ferula multifida*, *Valeriana edulis* and *Spiraea caespitosa*, and from the leaves of *Artemisia tridentata*.

THE annual report for 1910 issued by the director of Rothamsted Experimental Station reflects to a great extent the unfavourable conditions that prevailed during the summer. The yields of wheat, barley, and grass crops were all low, but mangolds were good, and a second crop of clover on one field was very large. A noticeable feature on the barley plots was the value of phosphate manuring, which becomes more marked in a wet and cold season. Striking evidence was obtained of the beneficial effects which result from preceding wheat with a leguminous crop. A report by the director and Dr. E. J. Russell on the soils in the south-east of England is being published by the Board of Agriculture, and a paper by Miss Brenchley dealing with the weeds prevalent in Rothamsted district is announced.

FROM the account of the gardens at Llanover, Monmouthshire, contributed by Mr. G. Went to *The Gardener's Chronicle* (May 6), it is evident that natural conditions and careful management have combined to produce a magnificent collection of trees. Mention is made of some fine specimens of *Sequoia gigantea* and a lofty tulip tree, all exceeding a height of 100 feet, and of specimens of *Alianthus glandulosa*, *Abies Smithiana*, and *Pinus excelsa*

almost as high. Fuchsias of the types of *globosa* and *Riccartonii* attain large proportions, and a plant of the *nobleanum* variety of *Rhododendron caucasicum* was estimated to cover an area 30 feet in diameter.

A double number of *The Indian Forester* (January and February) contains an article on forest railways for the extraction of timber, communicated by Mr. F. A. Leete, in which he describes an original type of monorail experimentally tried in Burma; a note on wood-pulp testing, by Mr. W. Raitt; and a report on the system of afforestation with field crops in Berar. Mr. Raitt states that four Indian conifers, *Picea Morinda*, *Abies Pindrow*, *Pinus excelsa*, and *Pinus longifolia*, yielded long-fibred, strong pulps of good colour and quality, while weaker but useful pulps were obtained from six hard-wood trees, including *Bombax malabaricum*, *Populus ciliata*, and *Ficus bengalensis*.

A thick volume, issued as vol. xiv., part i., of "Contributions from the United States Herbarium," is devoted to a compilation dealing with the lichens of Minnesota, in which Mr. Bruce Fink presents the data collected and conclusions formulated by several years' field work and study. Under the only American order of Ascolichenes, four suborders, Coniocarpineæ, Graphidineæ, Discocarpineæ, and Pyrenocarpineæ are delimited. The largest family, the Lecideæ, contains eight genera, of which Lecidea, Bacidia, and Buellia are the more important; Cladonia and Lecanora are also large genera. Artificial keys are provided for genera and species, and illustrations for one species of each important genus. Further, to add to its value as a practical handbook, the author has given an introductory account of lichen structures and modes of reproduction. Since the lichen flora of Minnesota is fairly representative of a large portion of the northern area of North America, the volume should be useful to British lichenologists for purposes of comparison.

The agricultural experiment station attached to the Purdue University, Indiana, has succeeded in coming into very close contact with the farmers by means of educational trains, field trials, and illustrated circulars dealing with various practical questions. The educational train is almost unknown in this country; it consists of a coach for the staff, two "audience coaches," and a "palace-horse" car, in which are kept the animals used for the demonstrations. The train stops at convenient centres, and is met by the local farmers; the staff then give lectures and demonstrations dealing with matters of local interest. Of the popular circulars recently to hand, we need only mention one on wheat, in which stress is laid on the fact that the average yield in Indiana is only 13·3 bushels per acre, whilst on the college farm it is 28 bushels per acre. The farmer is advised how he may make up the deficiency and improve his own crops.

With the union of the South African colonies, the issue of separate agricultural journals has become superfluous, and they are now all merged into a new *Agricultural Journal of the Union of South Africa*, issued monthly in English and Dutch by the Department of Agriculture. The first number contains articles on the cultivation of recently introduced crops, cotton, bananas, citrus fruits, and others, and records experiments on partial sterilisation of soil for tobacco seed beds. Dr. Theiler describes "stiff-sickness" in cattle, a disease very similar to laminitis in horses, which he traces to *Crotalaria burkeana*, a plant occurring in the pastures. Altogether the new journal reflects very great credit on all concerned in its production.

Three diseases of groundnut have been studied by Mr. F. W. South in the West Indies. A rust fungus, *Uredo arachidis*, is of very general distribution both on imported and on local varieties throughout all the islands. The amount of damage it is capable of causing appears to vary in different islands, as does the success of the control measures employed. A leaf-spot fungus, *Cercospora personata*, is more local and not as yet very serious. A root disease caused by a fungus not identified occurs in a number of the islands; its host plants are numerous and of a very general nature. No adequate method of control is known. Mr. South's observations are published in the West Indian Bulletin, vol. xi., No. 3.

We have received the first report of the Mine Rescue Station Commission of the State of Illinois, which contains some interesting information. Illinois has taken the lead in the United States, and has been the first State to provide a rescue service for its coal mines. Three stations have been built, namely, at Benton, Springfield, and La Salle. In general design and equipment they appear not to differ greatly from those already erected in Great Britain, containing a lecture room, a training chamber, store rooms, &c. Unlike most European rescue stations, they also contain dormitories, which are probably rendered necessary by the conditions of the case; the intention appears to be that men being trained in rescue work should give up their whole time to the training, and should live at the rescue station during their period of training; it seems to be considered that a fortnight should suffice for this purpose. A novel feature here is the provision of a travelling rescue station in the form of an old Pullman car, which has been re-fitted so as to carry rescue appliances, oxygen cylinders, and other requisites; one of these will be attached to each rescue station, where it will stand on a siding ready, so that a locomotive can be coupled up to it and it can at once be taken to the scene of any accident. This idea is well worthy of adoption in other places. Of course, each of the Illinois rescue stations has also its motor-car for road work. The Commission does not express its preference as yet for any one of the numerous forms of rescue appliances that have been designed during the last few years, and rather implies that it has not yet come across any thoroughly satisfactory pattern. Finally, and as perhaps the most important point of all, let it be noted that this is a State enterprise, and that the State pays all expenses, which already amount to some 15,000*l.*

The Journal of Genetics, the first number of the first volume of which appeared in November, 1910, is, as stated in that issue, "a periodical for the publication of records of original research in Heredity, Variation and allied subjects. The Journal," so the announcement continues, "will also, from time to time, contain articles summarising the existing state of knowledge in the various branches of Genetics, but reviews and abstracts of work published elsewhere will not, as a rule, be included." The number before us contains a detailed and copiously illustrated account, by Dr. R. N. Salaman, of his hybridisation experiments with the potato. The characters dealt with pertain to certain morphological features of the leaf and tuber, and also to the colour of the latter. The same laws of dominance do not hold with the wild *Solanum etuberosum* as with the domestic varieties of potatoes. In *S. etuberosum* it was shown that immunity to the attacks of *Phytophthora infestans* is inherited as a recessive character. There is a very interesting paper by F. Keeble and Miss C. Pellew, in which it is shown that the character tallness, treated by Mendel as a single

character, is capable of analysis into two characters, length and thickness of internode, which are inherited independently of one another. L. Doncaster and F. H. A. Marshall describe the results of experiments designed, amongst other reasons, to test the hypothesis put forward by Dr. Rumley Dawson in his Causation of Sex, that the right ovary gives rise exclusively to male-producing and the left ovary to female-producing ova. The results do not support Dr. Dawson's view. The journal is well printed and well illustrated, and is of a convenient size. We wish it success, which it will doubtless achieve.

In *Mitteilungen aus den deutschen Schutzgebieten*, Heft 1, K. Langbeck discusses the data obtained by means of self-registering raingauges on the Cameroon mountain. Situated near the equator, and swept by the south-west monsoon winds of the west coast of Africa, almost the heaviest rainfall in the world has been here recorded, Debundja receiving a mean annual rainfall of 10,140 mm., and Bibundi of 10,701 mm., so far as observations go at present. The article deals with the twelve months April, 1909, to March, 1910, and within this period the maximum rainfall occurs during the forenoon in the rainy season, and after midday in the dry months of the year. High values were recorded from 2 a.m. to 10 a.m. between June and October, and from noon to 4 p.m. and 6 to 7 p.m. between November and May. Utilising the data of previous years, a general excess of rainfall between 6 p.m. and 6 a.m. to the extent of about 60 per cent. is found, so that too great reliance must not be placed on a short period only. The investigation, however, is interesting, and as additional material is accumulated these apparent discrepancies will doubtless be explained. In the same number are published two maps of German South-west Africa, scale 1 : 200,000 and 1 : 400,000, which include the coast region from the Orange River up to lat. 26° S. A short description of the geography and the meteorology of the area is also given.

We have received from the observatory at Rio Janeiro a pamphlet entitled "Codigo Mnemo-Telegraphico," by Sr. N. Duarte, chief of the meteorological section, for the compilation and translation of weather telegrams, &c., by the use of words instead of figures, with the view of preventing mistakes in transmission. The principle bears resemblance to the *technica memoria* sometimes used in schools, with much advantage, for remembering dates, &c., by substituting letters for figures to form words. The present system is ingenious, and when the key is mastered the messages may be composed or deciphered without reference to the code. But it is not at all likely to compete successfully with the international telegraphic code now generally in use.

We have received from Major R. A. Marriott a pamphlet entitled "Why we may expect Warmer Winters," in which he seeks to revive a theory enunciated by his friend Major-General Drayson, whose scientific merits he wishes should be more fully recognised. We sympathise with his loyalty, but cannot accept his deductions. Major-General Drayson claimed to have discovered a "second rotation of the earth," and it is urged, as we think somewhat disingenuously, that there is evidence to show that General Drayson's reasoning was sound, and that errors have arisen in astronomical calculations from neglect of the principle. The practical effects of the neglect are urged as more important than the theoretical. Astronomers have assigned an erroneous value to the change of the obliquity of the earth's axis to the ecliptic. Instead of being limited to a quite small angle, the obliquity, it is urged, will change as much as 12°, naturally causing very great changes in the climate. Given the change, the result may be admitted, but inasmuch as the annual increment is only 40·9″, and the minimum is not reached until the year 2295, it is evident that from this cause there can be very little effect until after 2680 A.D., for whatever effect is produced in the first 385 years will be as slowly undone in the succeeding period of equal length. The author, of course, has greater scope when he applies his theory to geological changes, as in the case of the Ice age. But here his periods seem to be too short, as for the purposes of ordinary life they are too long. On this point, however, we cannot insist, for we do not know the date of the observed phenomena with sufficient precision to apply calculation. Within historic times, the facts are scarcely borne out. If we compute from General Drayson's data, the obliquity of the ecliptic at the earliest trustworthy observation, 230 B.C., we get the value 24° 19′ 20″, while the observed obliquity was only 23° 51′ 20″; the rate of change is made, therefore, more than twice as great as that of the observed. The price of the pamphlet is a modest penny, but unfortunately the name of the publisher is not given.

The difficulty of determining the true temperature of the radiating surface has been the greatest obstacle in practically all investigations of the radiating properties of metallic and other surfaces. A method of overcoming this difficulty is described by Mr. C. E. Mendenhall in vol. xxxiii., No. 2 (p. 91), of *The Astrophysical Journal*. In his experiments the author folded a piece of thin, flat, conducting ribbon of, say, platinum, parallel to its length, so that it formed a V-shaped cavity, and found that optical pyrometer observations of the temperature within the wedge-shaped aperture, particularly in one with reflecting walls, give the true temperature of the outside surface of which the radiation is to be studied. Various experiments with filaments of pure platinum verified the accuracy of the method.

The stability of the atom under changes of molecular kinetic energy has been investigated anew by Mr. Henry Clo, who tested the stability by the resistance of the atom to ionisation; previous investigators have failed to find any certain dependence of atomic stability on the temperature. A specially constructed cylinder containing hydrogen or air was surrounded by an electric furnace raised to various measured temperatures, and the contained gas submitted to the ionising influence of the γ rays of radium. The results, published in a paper appearing in No. 2, vol. xxxiii., of *The Astrophysical Journal*, indicate that the ionisation of air is independent of the temperature of the gas to within 0·2 per cent., up to 600° C., and that the same independence is exhibited by hydrogen up to about 430° C.; a variation of above 200 per cent. in the absolute temperature of a gas fails to affect the stability of the atom sufficient to change the ionisation more than about 0·1 per cent.

The Bulletin of the Imperial Society of Naturalists of Moscow for 1910 contains (pp. 70–212) a long mathematical investigation, by Prof. Ernst Leyst, of formulæ representing the action of one magnet on a second. After dealing with the ordinary simple conception of a magnet as composed of two point poles of opposite sign, Dr. Leyst considers the much more complicated case—applicable to thin-walled hollow cylindrical magnets—where each pole is regarded as a fine circular ring of positive or negative matter. In the most general case the mathematical operations are heavy, and the resulting formulæ long; the

coefficient of one single term occupies eight pages. More especial attention is paid to the two standard positions of Gauss and the two standard positions of Lamont. These have been treated with more or less completeness by several previous magneticians, amongst whom Lamont and Borgen are specially mentioned; but, according to Leyst, few if any of his predecessors who have given formulæ for all four cases have wholly escaped printers' errors. Expression is given to the belief that the differences between results obtained for the horizontal component of the earth's magnetic force with different magnetometers are due in large measure to insufficiency in the deflection formulæ employed. There seems, however, no reference to the theoretical or experimental work on this question carried out of late years in this country and in India.

The Electrician for April 14 contains an abstract of the last three of Sir J. J. Thomson's Royal Institution lectures on radiant energy and matter. They dealt with the distribution of energy in the spectrum of a black body, the relation between radiation and absorption of a body, the character of the absorption of gases, and the nature of radiation and of light waves. The same number of *The Electrician* contains a summary of the lecture on the deflection of the positive rays of the vacuum tube as a new means of chemical analysis. Since the ratio of the deflections of a particle in the electric and magnetic fields depends on the quotient of the electric charge carried by the mass of the particle, an examination of the deflections allows some deductions to be made as to the composition and charges of the particles. Oxygen, for instance, appears to exist in the tube in nine modifications, and these help us to understand why the same chemical substance is so often capable of giving entirely different spectra under different conditions.

The illuminating engineers of America appear to have commenced a crusade against the evil of "glare" in artificial illumination, and the subject is given a prominent place in several of the American scientific journals. *The Scientific American* for April 15 contains an article on light and shadows ministering to eye comfort, by Mr. E. C. Chittenden, of the Bureau of Standards. He considers that the present method of lighting large rooms by lamps concealed in recesses close to the ceiling gives too great uniformity of illumination to be pleasant to the eye, and prefers visible lamp fixtures provided with fittings of prism glass, which send the light in the direction required. According to the April number of *The Illuminating Engineer of New York*, an American Association for the Conservation of Vision has been formed, and the editor sums up a few of the questions at issue as follows:—(1) Is glare so injurious to the eyes as is generally believed? (2) Is indirect lighting good or bad? (3) Is the Cooper-Hewitt lamp injurious to the eyes?

A supplement to *The Electrician* of May 12 devotes nearly 200 pages to special articles on the present position of electric power in mining. Since the corresponding supplement was issued three years ago, new rules have been issued by the Home Office dealing with the use of electrical appliances in mines, and one of the articles is devoted to the elimination of risk from explosion and from shock in the use of electricity. Other articles deal with the supply of power, either from a public or from a private station to the colliery, the winding plant, the wiring of the mine, coal-cutting machinery, haulage plant, pumps, switches, and electric hand lamps. Each is written by a man well qualified to deal with his subject, *e.g.* Prof. W. M. Thornton, Mr. H. J. S. Heather, and Mr. W. B. Shaw.

Messrs. Negretti and Zambra have submitted to us a pair of folding prismatic binoculars, which we have carefully tested. The chief feature is the manner in which the binoculars may be folded for ease in carrying to fit into a case $3\frac{1}{2}$ inches wide and only *one inch thick*. This is achieved by mounting the prism in which the first two reflections occur separately from the prism producing the last pair of the four reflections of the usual prismatic system. This has not resulted in any sacrifice either in power, aperture, or—so far as we can see—in illumination. We have ascertained that the magnification and field of view as given by the makers, viz. 5·5 diameters and 8·3°, are approximately correct, and these compare very well with the ordinary prism-binocular. The focussing is smooth, the introcular distance can be adjusted, and for a small range the focus can be separately adjusted for each eye. The only criticism we have is of the spring catches which hold it in position for use, which do not appear quite strong enough. Incidentally, the glasses provide very interesting evidence of the power we possess of rotating our eyes in their sockets (by means of the oblique muscles). If the spring catches are released while looking through the glasses, and the bodies are slightly rotated, as in folding them, the images seen by the two eyes rotate in *opposite* directions. It will be found that for a few degrees either way the eyes are able to follow, and to fuse the images into one.

In the paragraph on a fresh-water rhizocephalan in our last week's issue, the *Records of the Indian Museum* is quoted as *Records of the British Museum*.

OUR ASTRONOMICAL COLUMN.

The Bright Meteor of April 30.—Mr. Harrison Hill, of Abbey Road, N.W., writes to say that he also observed the brilliant meteor which was seen, as reported in these columns last week, by the Rev. T. E. R. Phillips. At midnight on April 30 Mr. Hill's attention was arrested by a sudden and bright light, which appeared to be a large star, in the S.W. sky. This object increased rapidly in size and apparent brightness, and then disappeared. Although Mr. Hill has frequently observed "shooting stars," this meteor especially impressed him by reason of its lack of apparent motion and its exceeding brightness.

The Spectrum of Nova Lacertæ.—A comprehensive study of the spectrum of Nova Lacertæ is published in No. 194 of the Lick Observatory Bulletins by Prof. W. H. Wright. Spectrograms were secured early in January with spectrographs attached to the 36-inch and 12-inch refractors, but subsequent observations were prevented by a protracted storm which set in after January 6. Altogether, some 140 wave-lengths are given as positions of lines, or as maxima, minima, or limits of bands. As remarked by Prof. Wright, the interpretation of this complex structure of the spectrum is a difficult problem in which great caution must be used. There is one point to which he directs specific attention, however. In the comparison iron-spark spectrum the air lines appear as usual, and show a large measure of agreement with many of the bright-band maxima in the star. This is shown by a table comparing the nitrogen wave-lengths given by Exner and Haschek and Neovius with the stellar wave-lengths. But it should be noted that the strongest nitrogen line, λ 3995, is absent from the star spectrum, as are also some of the fainter lines in the spectrum of the gas; neglecting the lines of intensity two and less, there is, however, a striking agreement except for some discrepancies in wave-length such as might easily occur in the measures of the involved nova spectrum. This is interesting and suggestive, but, as Prof. Wright says,

the existence of nitrogen in the star can hardly be said to be proved.

Bright bands, possibly related to two found in gaseous nebulæ, were seen in the January spectra of the nova, and a spectrogram taken on March 30 shows that the nova had then arrived at the nebula stage; bands at or near λλ 4861, 4959, 5007, 5752 ±, and 6563 were recorded.

THE RADIAL VELOCITY OF α CYGNI.—The study of thirteen spectrograms taken at the Pulkowa Observatory confirms the variability of the radial velocity of α Cygni, first discovered at the Yerkes and Lick observatories in 1910. In No. 38 of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo* Herr G. Neuimin publishes the data and results he obtained from the measures, and directs special attention to the fact that the velocities deduced from eighteen metallic lines vary considerably and consistently from those obtained from the measures of the three hydrogen lines Hδ, Hγ, and Hβ. The range of velocities, relative to the sun, as derived from the metallic lines, is from −17·6 to +2·47 km., and from the hydrogen lines −21·1 to +5·5 km.; the mean difference between the two sets of velocities, from seven plates on which both sets were measured, is +9·1 ± 1·21 km. per sec.

Prof. Belopolsky confirmed this result by independent reductions, using seven iron, two each calcium and magnesium, one helium, and four hydrogen lines. Apparently the helium line agrees with the hydrogen lines in differing consistently from the lines of the various metals; the results show a mean difference, metallic − hydrogen, of +7·1 ± 0·9 km. On two of the spectrograms the calcium lines H and K are apparently double.

THE DISTRIBUTION OF VARIABLE STARS.—Plotting the positions of 678 variable stars given in the *Annuaire du Bureau des Longitudes* (1909), M. Anestin, of Bucharest, finds the known agglomeration in the Milky Way and the condensations in Aquila, Lyra, Cygnus, Sagitta, Cepheus, and Cassiopeia. Near the N. pole of the galaxy, between 10h. and 12h. R.A. and +20° to +40° declination, there is but one variable as compared with twenty in a fourth the area in Aquila and Lyra. Long-period variables show a tendency to grouping, but the irregular variables are more evenly distributed except for an agglomeration in Cygnus.

In the southern hemisphere, 664 variables crowd towards the galaxy, but between 6h. and 10h. R.A. there appears a space almost devoid of them, which covers part of the region, 6h. 30m. to 14h., also devoid of novæ. The region thus avoided by the temporary and variable stars is, as M. Flammarion pointed out, the least complex and least dense large area of the Milky Way (*L'Astronomie*, April, p. 184).

THE VARIATION OF S ARÆ.—No. 3, vol. xxxiii., of *The Astrophysical Journal* (April, p. 197) contains an interesting paper by Dr. A. W. Roberts, in which the author propounds a theory to account for the peculiar light-curves of such "cluster-variables" as S Aræ. The general features of this type of light-curve are short period, a long stationary minimum, a very sudden rise to maximum, and a leisurely decline to minimum. After carefully studying the variation of S Aræ, Dr. Roberts suggests that such a light-curve may result from a combination of two distinct variations. The primary curve would be that of a Cepheid variable, depending upon an intrinsic variation of a bright star. The superimposed curve would be that of an Algol variable, and the theory demands that this shall be caused by the eclipse of the very bright, but relatively small, satellite by a larger, dark primary; the satellite is the Cepheid variable. There are various objections to such a theory, but the main observed facts are in favour of it. The great variation of the smaller star might be explained by the fact that the distance separating the pair is very small; thus the smaller companion may be revolving in a path which carries it through the rarer atmosphere of the larger star, the absorption of this atmosphere accounting for the change in apparent brightness.

THE "ANNUAIRE ASTRONOMIQUE" FOR 1912.—The Royal Observatory of Belgium is to be congratulated upon getting this useful *Annuaire*, for 1912, published so early, for although it necessitates omissions from the *revue* section, it facilitates the work of a number of the practical astronomers the book is intended for. The comprehensive list of observatories is omitted from this issue, but is to be republished every two or three years. In addition to the usual tables, ephemerides, "phenomena," &c., there are valuable articles on the tides, the universal time system, and, in a supplement bound with the *Annuaire*, Dr. Stroobant's work on the recent progress of astronomy.

THE ROYAL SOCIETY CONVERSAZIONE.

THE gentlemen's conversazione of the Royal Society was held in the society's rooms at Burlington House on Wednesday, May 10. The fellows and guests were received by Sir Archibald Geikie, K.C.B., president of the society, and many objects and experiments of scientific interest were exhibited. During the evening the Hon. R. J. Strutt gave a lecture on the afterglow of the electric discharge and on an active modification of nitrogen, and Mr. Joseph Barcroft lectured on adaptation to high altitudes in relation to mountain sickness. Experiments were shown by Prof. Strutt to prove that the well-known "afterglow" of Geissler tubes containing air is a phosphorescent flame, produced by the reaction of nitric oxide and ozone formed in the discharge. It was shown that nitrogen gives rise to a different kind of afterglow. The latter is regarded as resulting from the formation of an active modification of nitrogen, which slowly reverts to the ordinary form with luminosity. It was also shown that acetylene is spontaneously inflammable in this active nitrogen, and burns to cyanogen, the flame showing the characteristic spectrum of that gas.

Following our usual custom, we give a summary of the official description of exhibits, related subjects being here brought together for convenience of reference.

The Astronomer Royal.—(1) Model of orbit of Jupiter's eighth satellite. The model shows the path of the satellite around Jupiter from 1908 to 1916 as predicted by Dr. P. H. Cowell from the observations made in 1908 and 1909. The orbits of satellites VI. and VII. and of the inner satellites are also exhibited to scale and in their proper planes. The scale is 80 inches equal 1 solar unit, or 1 inch equals 1,160,000 miles. (2) Globe showing the motions of the two main star streams. The model has been constructed to show how an examination of the directions of motion of the stars reveals the presence of two great streams of stars. The statistics of the motions in different parts of the sky are summarised by the diagrams on the globe; it can be seen that for each region there are two "favoured directions" of motion in which the stars move in greatest numbers. These directions are traced on the globe, and converge to two apices. *The Director, Khedivial Observatory, Helwan, Egypt.*—Photographs of Halley's comet taken with the 30-inch Reynolds reflector by Mr. H. Knox Shaw. The photographs exhibited cover the period from April 16 to June 10, 1910. *Lowell Observatory, Arizona, U.S.A.*—(1) Photographic negatives of Halley's comet taken at the Lowell Observatory, May 4 to June 5, 1910. (2) Plates of slit spectrograms of Halley's comet. (3) Plates of slitless spectrograms of Halley's comet. Three important deductions follow from the photographs and spectrograms:—(i) The identification, by Dr. Slipher, of the three chief bands in the comet's spectrum as those which Mr. Fowler has shown to be the bands of carbon monoxide when under very low pressure. (ii) The totally diverse gaseous constitution pointed out by Dr. Slipher between the emissive constituents of the head and tail—the bright gases of the one being strong where those of the other are weak, and *vice versa*. (iii) Measurements by Prof. Lowell on knots in the photograph showed an accelerated velocity away from the head, as follows:—

	Angular distance from the nucleus to the point measured in the tail	Velocity of the point of the tail away from the nucleus
Knot 1	1° 28′	13·6 miles a sec.
Knot 2	3 12	17·2 ,, ,,
Knot 3	4 36	10·7 ,, ,,
Knot 4	6 15	29·7 ,, ,,

This, taken in connection with the spectrograms, disclosed

the significant fact that the accelerated knots were composed, to the extent of 75 per cent. of gases, not of solid particles, and that, therefore, *molecules* not only could be, but actually were, repelled by the action of the sun—contrary to current theory. *The Royal Astronomical Society.*—Series of photographs of nebulæ taken by Prof. G. W. Ritchey with the 60-inch reflector of the Mount Wilson Observatory, California, in 1910. *Mr. A. Fowler, F.R.S.*—Spectrum photographs showing the composition of the tails of comets. The spectra of the tails of comets exhibit a number of double bands, which the photographs prove to be identical with bands obtained from vacuum tubes containing carbon monoxide at a pressure of about 0·01 mm. An additional band, due to nitrogen, was present in comet Morehouse. *Solar Physics Observatory, South Kensington.*—(1) Spectroheliograms of the sun. Obtained on Friday, April 28, 1911, about six hours before the time of total eclipse at Vavau, and on Saturday, April 29. Composite pictures are shown of the prominences on the limb and the flocculi on the disc, taken in K_2K_3 (calcium) light. (2) Diagrams illustrating the southern hemisphere surface air circulation. (i) Scheme of general suggested circulation. (ii) Curves showing time difference of pressure changes. (3) Observations of Halley's comet at Fosterdown, Caterham. (i) The temporary observatory showing the three instruments used: 9-inch Henry prismatic camera, 10 feet focus, with one prism of 45° angle; 2-inch quartz calcite prismatic camera, 18 inches focus, with one prism of 30° angle; 6-inch Dallmeyer doublet camera, 4 feet focus. (ii) Plate showing single and double nucleus of comet, drawing of visual spectrum, and photographic spectrum. (4) Photographic laboratory spectra. Showing the flutings of titanium, vanadium, and chromium, employed in the reduction of the spectra of Antarian stars α Orionis, ο Ceti, α Scorpionis, &c.

Prof. R. W. Wood (Johns Hopkins University, Baltimore).—(1) Fluorescence and resonance spectrum of iodine vapour, with monochromatic excitation. Development of band spectrum by presence of helium. Light from a mercury arc is focussed at the centre of a large glass bulb, highly exhausted, and containing a small crystal of iodine. The iodine vapour shows brilliant fluorescence, and the spectroscope shows resonance spectra excited by the two yellow and the green mercury lines, which can be observed separately by interposing absorbing screens between the lamp and the bulb. In a bulb containing iodine crystals and helium at 2 mm. pressure, excited in the same way, the spectroscope shows the band spectrum of iodine superposed on the resonance spectrum. The collisions with the helium molecules apparently effect a transfer of energy from the excited electron system in the iodine molecule to all the other systems. In helium at 10 mm. the band spectrum alone is seen, as in the case of iodine vapour *in vacuo* excited by white light. (2) Echelette diffraction gratings. Gratings ruled with groove of known form on gold-plated copper by a crystal of carborundum. Used for work in the infra-red, and for experimental determination of the energy distribution in the spectrum in relation to the wave-length and the form of groove. The oblique faces of the grooves show a curious oblique image by reflection when the incidence is perpendicular to the plate. *Mr. Eric S. Bruce.*—Photographs and prints descriptive of types of dirigibles. The exhibit is descriptive of various types of airships on the lighter-than-air principle. *Mr. W. H. Dines, F.R.S.*—Working model of winding gear used for kite-flying at Pyrton Hill. *Prof. P. V. Bevan.*—Anomalous dispersion in metallic vapours. Anomalous dispersion at the red lines of potassium. The dispersion is produced by the method well known through the experiments of Prof. R. W. Wood with sodium vapour. Dispersion is also shown at the two violet lines of rubidium.

A. W. Clayden.—An actinograph or radiation recorder. The pen records the difference between the temperatures of two similar bimetallic spirals, of which one is blackened and exposed to radiation, while the other is bright and is shaded by a polished tin cover.—*Sir Henry Cunynghame and Prof. Cadman.*—(1) Contrivance fitted to miners' safety lamps for the detection of fire-damp. The contrivance consists of a small piece of asbestos soaked in carbonate of soda, which can, at will, be introduced into the flame of the lamp without the necessity of lowering it. The presence of small percentages of gas is immediately indicated by the appearance of an orange-coloured cap of the same character as appears when a wire, charged with soda, is introduced into a Bunsen gas flame. (2) A differential hygroscope (Sir Henry Cunynghame). The device consists of two thermometers, one with a wet and the other with a dry bulb. Instead, however, of being placed apart as usual, the stems of the two are brought into juxtaposition. They are not equally divided, but are so arranged and divided that when the top of the column of one of them sinks below the top of the column of the other, any desired hygrometric state of the air is at once seen by simple inspection without any scale or reference to any table, and irrespective of the temperature.

Messrs. Elliott Brothers.—The Anschütz gyro-compass. A practical application of a gyrostat as a mariner's compass. The apparatus consists of a gyrostat so suspended that its axis points to the true north, thus avoiding the necessity of any considerations of magnetic variation. The "directive force" is considerable, and on that account the apparatus can be made use of to transmit its indications to various points in a ship. *Mr. A. Mallock, F.R.S.*—Model of a "detached escapement" for pendulum clocks. The pendulum is free, in the sense that during the swing it makes no intermittent contacts with any solid. Near the end of each swing an electric contact is made by a fine wire dipping in a mercury cup. The current then established passes through the coils of an electromagnet, which, by means of a "remontoir" working a reciprocating lever, causes a very weak spring to act so as to maintain the oscillation. Constant density in the air surrounding the pendulum is approximately secured by the covering bell glass, the edge of which dips in a deep but narrow annular canal partly filled with mercury. An alteration of 1 inch in the height of the barometer alters the density of the enclosed air by about one part in a thousand. *Sir William Ramsay, K.C.B., F.R.S., and Dr. R. W. Gray.*—A micro-balance. This balance, made essentially from the designs of Steele and Grant, registers about 1,20,000th of a milligram. It is comparatively insensitive, one at University College being more than ten times as sensitive. The plan of adding small weight was worked out at University College; it consists in altering the apparent weight of the air in a sealed quartz bulb, suspended from one arm by a silica fibre, by altering the pressure of air in the balance-case. It was with a balance of this type that the density of niton was determined with less than one-tenth of a cubic millimetre. *Mr. J. J. Manley.*—Analytical balance with protected beam. The beam of this balance is completely enclosed by an auxiliary inner case, which is made of magnalium and fitted with plate-glass shutters. Beneath the base-plate of the case, baffle-plates are attached to the pan-suspensions and pointer. These baffle-plates intercept and deflect any convection currents ascending from the experimenter's hand, and so prevent them from striking the beam. By these combined devices, very great uniformity in the temperature of the balance beam may be maintained. *The National Physical Laboratory.*—A simple apparatus for measuring small thicknesses and displacements (exhibited by Mr. E. H. Rayner). *Dr. A. O. Rankine.*—A method of measuring the viscosity of a small quantity of gas. *The National Physical Laboratory.*—Portable potentiometer for temperature measurements with thermo-couples (exhibited by Dr. W. Rosenhain and Mr. S. W. Melsom). *Mr. Alfred W. Porter, F.R.S.*—An anomaly in the lagging of wires and pipes. A sheath consisting of a bad thermal conductor (like asbestos or glass) surrounding a sufficiently narrow hot body assists the escape of heat instead of retarding it. This effect is shown by means of a platinum wire heated electrically. Parts of the wire are covered with glass. Where the cover is the wire keeps quite cool (at about 100° C.) even when the bare part is at 1000° C. Examples of lagged steam-pipes are also exhibited.

Sir William Crookes, O.M., F.R.S.—Collection of old radiometers and otheoscopes. These experimental instruments were made by the exhibitor during his researches on repulsion resulting from radiation, and were used to illustrate the papers when they were read before the Royal Society in the years 1875–8. *Sir James Dewar, F.R.S.*—Radiometer acting by the pressure of mercury vapour given off by the liquid between the ordinary temperature and

$-25°$ C. Radiometer, in concentrated beam of electric arc, stopped by charcoal liquid-air vacuum, and started again by mercury vapour at a pressure of about one fifty-millionth of an atmosphere. Activity again arrested on freezing out the mercury vapour in liquid air. *Mr. Francis Fox.*—(1) Radium bromide from pitchblende found in Trenwith Mine, St. Ives Consolidated Mines, St. Ives, Cornwall. (2) Specimen of rich pitchblende ore from the mine. *Mr. C. T. R. Wilson, F.R.S.*—Exhibition of the tracks of ionising particles in gases. (1) Tracks of α particles from radium through air. (2) Tracks of ionising particles produced by X-rays in air. The trail of ions left by each ionising particle is made visible by condensing water upon the ions. *The National Physical Laboratory.*—Ionisation in the electric furnace (exhibited by Dr. J. A. Harker, F.R.S., and Mr. C. G. Eden). *Prof. J. Norman Collie, F.R.S.*—Tubes showing electric discharge through neon. (1) Tubes showing the electric discharge through neon at high pressures. (2) Table showing the canal rays in neon. *Mr. C. W. Raffety.*—Enlarged photographs of the forms assumed by the brush discharge in air at reduced pressures. *Prof. E. Wilson and Mr. W. H. Wilson.*—(1) An improved high-tension discharge apparatus. (2) A high-tension electrostatic wattmeter (Prof. E. Wilson). *Prof. J. A. Fleming, F.R.S.*—Experiments showing visibly the oscillatory discharge of a condenser by Hemsalech's method, and its magnetising action on finely divided iron cores. *Mr. S. G. Brown.*—(1) Telephone relays. (2) Model of electrical stethoscope.

Prof. A. Liversidge, F.R.S.—(1) Series of sections of gold nuggets and photographs to illustrate the same. (2) Specimens and sections of Australian meteorites, and photographs. *Prof. W. J. Pope, F.R.S.*—Photomicrography in natural colours. Photomicrographs of rock sections, chemical preparations, and crystal interference figures are exhibited. The photographs were taken between crossed Nicol prisms by the Dufay process, in which the colours of the objects are reproduced. *Prof. E. G. Coker.*—Interference colours produced by transparent materials under stress. A beam of plane or circularly polarised light is passed through a plate of xylonite cut into any selected shape and loaded in any convenient manner. The material when stressed behaves like a doubly refracting crystal, and the two rays, into which the incident beam is divided, produce interference colours when passed through a Nicol's prism. The stress distribution may be inferred from the colour fringes produced. *Prof. J. Eustice.*—Experiments on stream-line motion in curved pipes. By means of filaments of coloured water, it is shown that when water is flowing from a straight to a curved pipe some of the filaments approach the sides of the pipe and cross from the outside to the inside of the curve, close to the walls. Several colours are used in the glass pipes, and the interlacing of the filaments caused by the vortex motion is clearly exhibited. *Mr. C. E. Larard.*—Twisted, cylindrical, and castellated metal specimens. *Mr. J. E. Marsh, F.R.S.*—(1) Experiments showing the separation of a homogeneous solution into three layers when the solution is warmed. (2) Solutions of certain salts in ether not miscible with excess of ether.

Prof. W. M. Thornton.—The electric charges associated with vegetable cells. When an electric current is passed through a weak emulsion, in water, of typical animal and vegetable cells, such as blood corpuscles, yeast, bacteria, and unicellular algæ, the animal cells appear to be driven to the positive pole, the vegetable cells to the negative, provided that the latter are from fresh, active growths. The movement reverses with the direction of the current, and is dead beat. *The Director, Royal Botanic Gardens, Kew.*—Cushion plants and their seedlings. The exhibit includes specimens and photographs of the balsam bog of the Falkland Islands (*Azorella glebaria*, A. Gray, Umbelliferæ), with a series of living seedlings raised in the Royal Botanic Gardens, Kew. *The John Innes Horticultural Institution.*—(1) "Chimæras" and Winkler's graft-hybrids, from Prof. E. Baur (Berlin). (2) A case of coupling in Pisum, between roundness of seed and power to produce tendrils, in the ratio 63 : 1 : 1 : 63. *Mr. A. D. Hall, F.R.S.*—A biological factor in soils limiting the activity of bacteria in producing plant food. Bacteria play an important part in the production of plant food in the soil from the accumulated organic residues; indeed, when other things are equal, the fertility of the soil is closely connected with the amount of bacterial activity. It has been shown, however, that a factor exists in ordinary soils limiting the activity of bacteria; this factor is biological, and appears to consist of large destructive organisms. When soils are kept in moist, warm conditions and well supplied with organic matter, as in a greenhouse, there is a marked accumulation of the limiting factor; a similar accumulation occurs in the soils of sewage farms. On the other hand, dry soil conditions are unfavourable to the factor. Heating the soil to 55° C., prolonged drying at lower temperatures, or treatment with various antiseptics such as toluene, kills the factor and leads to a marked increase of bacterial activity. In field and greenhouse soils there is a large production of plant food, and in sewage-farm soils an increased rate of decomposition.

Prof. H. E. Armstrong, F.R.S., and Dr. E. F. Armstrong.—The action of stimulants (hormones) in promoting enzymic activity. The specimens shown are in illustration of results described in recent communications on the functions of hormones in stimulating enzymic change in relation to narcosis and the phenomena of degenerative and regenerative change in living structures, and on the functions of hormones in regulating metabolism. Like the barley grain, leaves are shown to be provided with protective differential septa through which strong acids, salts generally, and substances such as the sugars do not pass, but which are freely permeable by organic vapours, weak acids, ammonia, and a few salts (mercuric chloride, &c.). The passage of the excitant into the leaf is shown in the case of the common laurel (*Prunus laurocerasus*) by the liberation of hydrogen cyanide, and in the case of the spotted Japanese laurel (*Aucuba japonica*) by blackening due to the decomposition of the glucoside aucubin. The active substances are for the most part non-electrolytes, which have little, if any, chemical activity. *Prof. R. T. Hewlett and Mr. J. E. Barnard.*—(1) The bactericidical action of light produced by a quartz mercury vapour lamp. Experiments on the bactericidical action of light indicate that a quartz mercury vapour lamp, in relation to its current consumption, is the most economical source at present available. The most actively bactericidical region in the carbon arc spectrum is that portion of the ultra-violet between λ 3280 and 2260. These radiations are produced freely by the mercury arc, and the action extends still further, practically to the limit of transmission by quartz. Owing to the almost entire absence of heat radiations in the mercury arc, any arrangement for heat absorption becomes unnecessary. This is an advantage of considerable moment, as any such method at present in use substantially increases the necessary exposure. (2) Apparatus for disintegrating bacterial and other organic cells. The apparatus consists of a metal containing vessel, in which a number of steel balls are placed, and which is caused to rotate. The balls are kept in position at the periphery of the vessel by a central steel cone, which, by suitable means, is prevented from rotating. Grinding action takes place between the steel balls and the inner surface of the vessel. The efficiency of the method is high, as after subjecting bacteria to the grinding process for from fifteen to twenty minutes, very few, if any, whole cells remain. Even those that are apparently whole have evidently parted with their cell contents, as may be demonstrated by the difficulty of staining them by any recognised bacteriological method. *Mr. Henry Crookes.*—Photographs and living cultures of *B. phosphorescens*, showing the germicidal action of some metals. Nutrient gelatin-agar is poured into Petri dishes containing small pieces of metal; when the medium has set, the surface is infected with *B. phosphorescens*. After twenty-four hours the bacteria grow luxuriantly, except in a zone surrounding the piece of metal, which remains entirely sterile. The extent of this *death-zone* varies with different metals. *Prof. M. C. Potter.*—Electrical effects accompanying the fermentative activity of yeast. The apparatus shown consists of a glass jar containing a porous cylinder, and into each of these are introduced solutions of glucose of equal concentration. Two platinum electrodes are placed one in the jar and one in the porous cylinder, and on the introduction of yeast into one of the solutions, the whole constitutes a type of galvanic cell. *Mr. S. G. Shattock and Mr. L. S. Dudgeon.*—(1) Resistance of *Bacillus pyocyaneus* to drying *in vacuo*. Experi-

ments devised to ascertain how far this factor might be *per se* lethal to bacteria in insterstellar space. A growth of *Bacillus pyocyaneus* raised from a thin film of a culture (made in peptone water) spread on glass and kept dried *in vacuo* for four months. The vacuum was produced by Sir James Dewar's method (a bulb of powdered charcoal surrounded by liquid air, after exhaustion by pump); after five days the vacuum was maintained by sealing off the tube. Light was excluded throughout. The bacillus when dried in the air (light excluded) dies within three months. The behaviour of this bacillus *in vacuo* is exceptional. Its maintenance of vitality corresponds with that of certain seeds under similar conditions. (2) Microscopic sections of urinary calculi from the human subject.

Hon. N. C. Rothschild.—Model of *Xenopsylla cheopis*, the tropical plague flea. *Mr. F. Enock.*—Photomicrographs of new species of British Mymaridæ. The insects comprised in the subfamily Mymaridæ are ovivorous in their habits, laying *their* eggs in those of various Homoptera and Coleoptera. Hitherto only thirty-five species have been recorded. The photomicrographs are part of the hundred to one hundred and fifty new species (many as yet unnamed) collected or bred during the past thirty-five years. *Sir W. B. Leishman, F.R.S.*—A parasite found in cases of infantile splenic anæmia. In cases of this disease, occurring in Tunis, Italy, Sicily, Malta, Portugal, and elsewhere, a protozoon—*Leishmania infantum*, Nicolle—has been found by C. Aicolle and others. It resembles closely the parasite of kala azar—*Leishmania donovani*, Laveran—and that of Oriental sore.—*Leishmania tropicum*, Wright. The disease is extremely fatal, and appears widespread in the Mediterranean littoral. It has recently been proved to be identical with the fatal disease of children known as "ponos," which occurs in some of the islands of the Grecian Archipelago. The parasites have also been found in dogs, and it is probable that they are transmitted from the dog to the child by the bite of some insect. *The Lord Avebury, F.R.S.*—(1) Moth from Peru (Caligo) imitating an owl. (2) Elytron of beetle (Pachyrhynchus). (3) Butterfly from Borneo (Ornithoptera-Brookeana) mimicking the tips of the leaflets of a pinnate leaf emerging from the deep shade of a tropical forest; the midribs of the leaflets and the serratures of the edges are well represented. *Mr. H. Eltringham.*—Colour drawings illustrating African mimetic butterflies. *Prof. Poulton, F.R.S., Mr. C. A. Wiggins, Mr. W. A. Lamborn, and Mr. E. G. Joseph.*—Recent observations on mimicry, protective resemblance, &c., in African and South American butterflies and moths. *Dr. Deane Butcher.*—Osmotic growths. Osmotic growths are mineral productions simulating the forms of organic life. They are obtained by sowing a mineral seed or nucleus in a concentrated inorganic mother liquor. The nucleus reacts with the liquid to form an insoluble gelatinous precipitate at the surface of contact. This semi-permeable extensible membrane is distended by the osmotic pressure within, and grows by a process of intussusception, branching and putting forth terminal organs as it reaches a solution of lesser concentration. Osmotic growths were first described by Prof. S. Leduc in his work on "The Mechanism of Life." *Dr. G. H. Rodman.*—(1) Stereo-radiographs of monkey and tortoise. (2) A set of transparencies illustrating the development of the X-ray tube.

The Cambridge Scientific Instrument Company.—A new large sliding microtome. This instrument is a very powerful one, and will cut sections of superficial measurements up to 150 by 120 mm. (6 inches by $4\frac{3}{4}$ inches) through decalcified bone or cartilage. *Dr. W. J. Dakin.*—Sections showing stages in the sporogony of a new coccidian parasitic in the whelk. *The Marine Biological Association of the United Kingdom.*—(1) The culture of marine diatoms as food for developing larvæ. Some of the difficulties in the way of rearing marine larvæ in the laboratory have been overcome by keeping them in sterile sea-water and feeding them with cultures, as pure as possible, of suitable diatoms. (2) A collection of living marine animals from the neighbourhood of Plymouth. *Dr. W. S. Bruce.*—Deep-sea invertebrates: new or rare species taken by the polar ship *Scotia* in Antarctic seas during the Scottish National Antarctic Expedition (1902–4). *Mr. C. Tate Regan.*—Sketches illustrating instantaneous colour changes in sea-perches from the Bermudas. The sketches show colour phases observed in the New York Aquarium; these fishes are constantly changing their colour and markings; this is accomplished by the expansion and contraction of chromatophores, or pigment cells.

Mr. A. W. Clayden.—(1) Footprints from the Permian sandstones at Poltimore, Devon. Numerous footprints have been discovered during the last two years in the sandstones mapped in the Survey maps as Lower Sandstones They are of two types. Neither can be exactly matched from any of the known localities at which footprints of Permian age have been found, either in Great Britain, America, or Germany. They bear, however, a general resemblance to those obtained at Corncockle Moor and Penrith, though differing in detail. *Mr. R. W. Hooley.*—Skeleton of *Ornithodesmus latidens*, a pterodactyl from the Wealden shales of Atherfield, Isle of Wight. *Mr. W. Taylor.*—Remains of fossil reptiles from the Triassic sandstone of Lossiemouth, Elgin. *Prof. W. M. F. Petrie, F.R.S.*—Roman portraits, first century A.D. These portraits are painted with coloured wax upon thin panels of cedar. On some a fresh coat of paraffin has been now added for security. They were placed over the faces of the mummies and bandaged down round the edge. They are from the same cemetery, at Hawara, Egypt, as those in the National Gallery, a site now exhausted by the British School of Archæology in Egypt. *Dr. Vaughan Cornish.*—Photographs of surface waves. *Dr. Tom G. Longstaff.*—Mountain photographs.

THE IRON AND STEEL INSTITUTE.

THE annual general meeting of the Iron and Steel Institute opened on May 11 under the presidency of his Grace the Duke of Devonshire. The meetings were held at the Institution of Civil Engineers. The Bessemer gold medal for 1911 was presented to Prof. Henri Le Chatelier, of Paris, who attended for this purpose. The Carnegie gold medal was awarded to Mr. Felix Robin, who has conducted researches on the wear of steels and their resistance to crushing. Carnegie research scholarships have been awarded to Messrs. W. M. Guertler, of Berlin, G. Hailstone, of Birmingham, R. M. Keeney, of Colorado, U.S.A., and G. Dietrich Röhl, of Freiberg, Saxony. Messrs. J. Newton Friend, of Darlington, and T. Swindon, of Sheffield, have had additional grants made to them to enable their researches to be extended and completed.

Sixteen papers in all were presented for discussion; the principal points dealt with in a few of these are given below.

Dr. J. E. Stead contributed some notes on the welding up of blow-holes and cavities in steel ingots. The evidence advanced shows that, if the blow-holes in steel ingots are subcutaneous, *i.e.* under the skin and having no opening to the atmosphere, and the heating of the metal is sufficiently high, say 1000° C. and above, the cavities will weld up completely on being rolled or forged, provided they contain no foreign matter. It is doubtful whether pipe cavities can be so readily welded. The upper ends of the pipes in ingots are open to the gases of the heating furnace, and the cavities become coated with oxide scale, which prevents the metallic surfaces from coming into contact. If the pipe is deep and is bridged over at intervals with diaphragms of solid steel, it is not improbable that welding below these bridges might be effected, provided that the imprisoned gases become forced back into the steel and do not form layers of highly compressed gas between the steel surfaces, and so prevent these surfaces from coming into direct contact. Prof. Howe has suggested that forged steel blooms should be heated for a long time to above the welding point, so as to complete the reabsorption of the gas. This is based on two assumptions: first, that the gases of the cavities are capable of being forced by pressure into the hot steel and of becoming occluded there; secondly, that what gas is not so forced into the metal will diffuse into it during prolonged heating at a high temperature. Prof. Howe's suggestion calls for experimental evidence as regards the quantity of mixed gases or of any gas which can be forced by pressure into solid steel, and also as regards how much of it will come out again on removal of the pressure, and it is understood that a research has

been undertaken with the view of settling these important points.

Messrs. E. F. Law, W. H. Merret, and W. P. Digby have studied welds, and in their paper present the results of their investigations. Defining a weld as the actual fusion together of similar or allied metals, the authors have carried their investigations into the region of the characteristic microstructure of both good welds and unsuccessful attempts to produce welds, a subject on which there has hitherto been very little work done. No matter what the process may be by which two metals are welded together, there must always be an area, more or less sharply defined, of altered molecular construction. The authors show that each process of welding has its own hall-mark. For example, it is possible to say whether an electric weld has been made by an arc or by a resistance method from the evidence afforded by polishing and etching alone. Without annealing to restore the original structure, acetylene and water-gas welds have each their own marked characteristics. Resistance welds are seemingly less prone (with the exception, perhaps, of acetylene welds) to oxidation, but the extrusion of the metal renders good working, while the metal is still plastic, of supreme importance. Arc welds are most prone to oxidation, and many will hesitate to rely on such a process in those positions where corrosion is likely to occur. When the welded metal is not likely to be subjected to corrosion, the excellent fusion of the metal renders the method commendable. Flame welds should receive adequate working and manipulation while in their heated condition. Water-gas welds may be abnormal through the use of oxidising flames; acetylene welds certainly require annealing to break down the crystalline structure in the vicinity of the weld.

Prof. H. C. H. Carpenter has continued his investigations on the growth of cast irons after repeated heatings. His principal results up to date may be summarised as follows:—phosphorus tends to diminish growth; sulphur is never present in commercial cast irons in sufficient quantity to have more than a small influence on growth, which is, however, in the direction of retardation; manganese always retards the rate of growth, and diminishes the absolute amount in the majority of cases. Dissolved gases have no influence on the growth of an iron containing more than 3 per cent. of silicon; if the silicon does not exceed 1 per cent. they may be responsible for a growth of at least 10 per cent. The simplest and most rapid test for forming an opinion as to the growth that is liable to take place in any particular grey iron is to estimate the silicon, and then read off the approximate growth from the following table:—

Silicon, per cent.	Approx. growth, per cent.	Silicon, per cent.	Approx. growth per cent.
1·00	15·0	2·50	31·0
1·25	18·5	2·75	32·5
1·50	21·5	3·00	34·0
1·75	24·5	3·25	35·5
2·00	27·0	3·50	37·0
2·25	29·0		

If the iron contains 0·3 per cent. of phosphorus and upwards, the growth will be from 2·5 to 4 per cent. lower than the above figures, and if more than 0·5 per cent. of manganese is present, the rate of growth will be diminished and the amount of growth somewhat lessened. An alloy containing 2·66 per cent. of carbon, 0·587 per cent. of silicon, and 1·64 per cent. of manganese, showed no signs of growth after 150 heats, but, on the contrary, a slight contraction, viz. about 0·13 per cent. It is a tough material, and its mechanical properties were improved by this treatment. It begins to freeze at about 1340° C., and appears to be a suitable material for annealing ovens, rolls, fire-bars, and the grids of muffle furnaces. Probably it could be used for ingot moulds in an iron foundry without cracking.

The influence of impurities on the corrosion of iron is dealt with in a paper by Mr. J. W. Cobb. Interpreting the results of the author's experiments on the basis of the electrolytic theory of corrosion, it may be stated that pure iron is definitely electro-positive to most of its impurities. Among such impurities were found phosphide, sulphide, carbide, oxide, and silicate of iron. With carbon (graphite) the effects were particularly marked. All the iron alloys tried (excepting ferro-manganese) were also electro-negative to pure iron. With the sulphide and silicate of manganese little or no current flowed. Manganese and 80 per cent. ferro-manganese were found definitely electro-positive to iron. Every piece of commercial iron showed electrical effects with any other, and the effects between portions of the same piece were always sufficient to induce corrosion when the other conditions were satisfied. The presence of an impurity determines so many corrosion centres for iron, and so its influence depends more on quality and distribution than on quantity; thus a more homogeneous iron, even if chemically less pure, may be more highly resistant to corrosion. Other papers bearing on corrosion were contributed by Mr. P. Longmuir and by Messrs. J. Newton Friend and J. H. Brown.

Mr. W. H. Hatfield gives experimental results of the influence of vanadium upon the physical properties of cast iron. As an instance where vanadium has increased the life of locomotive cylinders, a case is quoted where cylinders made of cast iron not treated with vanadium wore 1 32-inch per 100,000 miles, whereas vanadium cast-iron cylinders showed only microscopic wear after running 200,000 miles. The present experiments show that additions of vanadium have a definite influence upon the physical properties of cast iron, and that this influence is mainly that of assisting the carbon to persist in the combined state. The persisting carbides, physically, do not differ materially from the normal carbides found in the cast iron; owing, however, to the actual presence of much of the vanadium in the carbide, that carbide is rendered more stable.

Messrs. A. McWilliam and E. J. Barnes give records of a lengthy series of experiments on the influence of 0·2 per cent. vanadium on steels of varying carbon content.

A paper on the chemical and mechanical relations of iron, chromium, and carbon is contributed by Profs. J. O. Arnold and A. A. Read. This paper is in continuation of the work of the authors already published, and gives an account of a number of experiments to determine the composition of the carbides separated from a series of annealed steels containing various percentages of chromium, the percentage of carbon being practically the same in each. The mechanical properties of these alloys under static and alternating stress, and their microscopic features, have also been investigated.

Iron-silicon-carbon alloys are dealt with in a paper by Dr. W. Gontermann. Some of the work performed at the Institute of Physical Chemistry at Göttingen has already been published, and the present report contains further particulars. The paper contains many diagrams and photographs of models showing graphically the properties of this series of alloys.

The magnetic properties of some nickel steels, and notes on the structures of meteoric iron, form the subject of a paper by Messrs. E. Colver-Glauert and S. Hilpert, of Berlin. A 5 per cent. nickel steel is hardest (magnetically) when quenched in the neighbourhood of 600° C. Quenching from higher temperatures results in a softer material. The changes which occur during thermal treatment of a 25 per cent. nickel-iron alloy are of a far more complicated nature than has been thought previously. At high temperatures there probably exists a product which may be preserved by rapid quenching, and is then strongly magnetic, and persists to the temperature of liquid air. This product does not exist in the region between about 600° C. and 900° C. There is very little connection between the magnetic properties and metallographical structure. There is no sharp magnetic change point for this alloy below zero, but the permeability gradually increases as the temperature decreases from about −50° C. to −180° C. The magnetic properties of a 33 per cent. nickel-iron alloy are only very slightly affected by thermal treatment. The microstructures of commercial nickel steels are practically the same as those of meteoric iron.

Messrs. A. McWilliam and E. T. Barnes complete their series of papers on steel with another on the properties of heat-treated 3 per cent. nickel steel.

Messrs. F. A. Daubiné and E. V. Roy, of Auboué, France, give an account of a process for the desiccation

of air by calcium chloride. The authors have investigated the appliances necessary for drying large volumes of air, and an appliance has been installed at the Differdauge Steelworks, Luxemburg, where it is now in normal working. In this process, the volume of air to be dried is made to traverse a mass of calcium chloride by means of a fan. Water is circulated through pipes bedded in the calcium chloride for the purpose of carrying away the heat generated by the absorption of water by the chloride. The hydration of the calcium chloride is arrested when the outside pellicle of the broken pieces commences to liquate, and a regeneration operation is employed for the purpose of rendering the calcium chloride capable of being employed for desiccating fresh volumes of air.

THE INTERNATIONAL PHILOSOPHICAL CONGRESS AT BOLOGNA.

THE fourth International Congress, which met at Bologna under the presidency of Prof. Enriques, was formally opened on April 6 by the Duke of the Abruzzi. It has been by far the best attended of the series, the total number of members being more than five hundred, and has been most hospitably entertained by the committee and the various municipalities. The general tone of the debates was much more cordial than usual, and the congress was fortunate even in its conclusion, for the next day a general strike was declared in the town and province.

It is difficult to say what exactly we should expect from such gatherings. It is clear that they can never produce any definite result; but the contact of personalities does sometimes bring into clearer light the existence of general tendencies of thought which otherwise might not have been so definitely perceived. This congress did bring to light the existence of such a tendency, and this was the quite evident decline in the importance of "system" in metaphysics. Philosophy does seem to be steering away from its traditional form. It is beginning to form a more fluent and a less rigid and systematic conception of truth. The working out of this tendency is connected with and was most clearly shown in the discussions of what really formed the main problem of the congress, the one it has spent the most time over—that of the relations between philosophy and science. This problem practically resolves itself into the question as to whether philosophy has any right to an independent existence, and it is perhaps one of the surest signs of the renaissance and vitality of the subject that it can discuss such a question with enthusiasm. This key-note of the congress was struck by Prof. Boutroux in his opening speech. Charming though this was in manner, it was not remarkable for profundity of thought, and offered no more original solution than that science, quite legitimately for its purposes, considered the world impersonally, and that it was the business of philosophy to reintroduce for a complete synthesis the element which science left out.

The same subject formed the theme the following day of a paper by that picturesque personality, Fra Gemelli, monk, biologist, and editor of the *Revista Nee-Scolastica*, which drew a reply from Prof. Hans Driesch, in which he explained the scientific use of his conception of entelechy, as distinct from Aristotle's more metaphysical use. The same subject continued to be discussed each day, until the debate finally culminated in the lecture, that was awaited with the greatest curiosity, that which was given by Prof. Henri Bergson, who is perhaps the most discussed and the most interesting philosopher in Europe at the present time. The main point he tried to establish in his *conférence* was that there were two different, and indeed inverse, ways of acquiring a knowledge of reality, the one that of scientific analysis, and another which he described as a kind of intuition, which should be the method of philosophy. Unfortunately, however, this is not the conception that philosophy has formed of itself. It has always attempted to use the same method as the science of its day; it has always attempted to do for the world in general what particular sciences have done for particular fields. It has conceived itself as the complete science, and therein lies the reason of its failure.

This is true historically; Greek philosophy is nothing but the extension into a different field of the method which prevailed in the science of the times, that of geometry. We get a similar phenomenon in modern philosophy. For the static geometrical concepts of the Greek, substitute the conception of scientific law, extend this to the general problem of reality as the Greeks did geometry, and you get the predominant types of modern philosophy. Always you get philosophy pursuing the same method as that of science, that of intellectual analysis, and having the same ideal, that of a complete science of existence. Now, said Bergson, philosophy, so long as it persists in following this method, is doomed to disappear, for it being obviously not wanted in the field of any particular and successful science, it must pursue its activities in the fields where science has not yet penetrated, *i.e.* in the field of the unknown; and this is not a very secure position for it, for as soon as science begins to penetrate the same field, and there is a contradiction between its conclusions and the conclusions of philosophy, it is philosophy that must give way, not science.

The only future of philosophy, then, lies in a recognition of the fact that it must pursue a different method entirely to that of science. It must give up the attempt to give a complete intellectual representation of the cosmos. There remains the allied question of the place of system in philosophy. Looking at the extraordinary complicated constructions of the great systematic philosophers, they certainly seem to have been animated by the conviction that they were creating a science of the real. But, said Bergson, that is only superficial appearance. If you study, say, Spinoza long enough, you will find that the whole elaborate system was merely the language by which he expressed one perfectly simple intuition, a thing which would be stated in one sentence if you yourself had been in a similar state and could at once recognise it. Here comes, then, the absurdity of explaining a philosopher by his sources—you only by that method catalogue the material by which he expressed himself. The important and central thing in a philosopher is a kind of intuition akin to that of the artist, and differing fundamentally from the kind of activity you get in science.

To get to the detailed work of the congress, particularly the work done in the various sections of logic, theory of science, esthetic, ethic, general philosophy, and psychology, one can only say that it was very abundant and very unequal, considerable so far as the magnitude of the subjects raised was concerned, and very little so far as actual results obtained go. This sterility was in great part due to the defective organisation of the congress and to the persistent keeping to the tradition of a free choice of subjects and free individual communication, with the result that there is never time to really discuss in a serious way the subjects raised. For this reason the most interesting work of the congress was done at the general meetings in the afternoon, and we refer here to the lectures which attracted the greatest attention.

The mathematician Henri Poincaré examined the question which has been raised by Boutroux and certain other philosophers as to whether the laws of nature may change. In a world which evolves continually are the laws, *i.e.* the rules under which this evolution takes place, alone exempt from all variation. Such a conception could never be adopted by the man of science without denying even the possibility of science, but the philosopher has the right to pose the question. Imagine a world in which there was no difference of temperature. Certain laws would be discovered by the inhabitants, such as, for example, that water boils at a certain fixed pressure. Suppose, now, that in course of time this uniform temperature changed, all the laws would now change; water would boil at a different temperature, and so on. Now, however perfect might be the conductivity for heat of this planet, it would doubtless not be absolute, so that one day a physicist of genius might with his delicate instruments detect these imperceptible differences. A theory might then be erected that these differences of temperature had an effect on physical phenomena, and, finally, some bold speculator might affirm that the mean temperature of the world had varied in the past, and with it all physical laws. May there not be some physical entity as yet as entirely unknown to us as was temperature to the inhabitants of this

imaginary world, which might vary and so create in the same way a change in all the laws?

Poincaré found something analogous to this, at any rate, in the ideas now being brought forward on the subject of mechanics, and which were later in the congress put forward by Prof. Langevin, whose name is known in connection with work in radio-activity. It is now asserted that the laws of mechanics, once considered absolute, are not so. They must be changed, or at least enlarged. They are only approximately true for the velocities to which we are accustomed, and cease to be so for velocities comparable to that of light. One might say that, as a result of the constant dissipation of energy, the speed of bodies has much diminished, since their activity gets transformed into heat. Thus remounting back to the past, one would find an epoch when velocities comparable to that of light were not uncommon, and when, as a consequence, the classical laws of dynamics were not true. But if, on the other hand, we consider these laws as only approximate laws, and consider the laws of motion of molecules as the true laws, we can keep our faith in the immutability of laws in general. There is not, then, a sole law that we can enunciate with the certainty that it has always been true in the past. Nevertheless, there is nothing to hinder the man of science from keeping his faith in the principle of immutability, since no law can descend to the level of a secondary law without being replaced by another law more general and more comprehensive.

Prof. Durkheim, the celebrated sociologist, examined the question of "judgments of value" and social ideals. How do they arise? They cannot be accounted for on utilitarian principles, for they are often in direct conflict, not only with individual, but even with collective utility. They assert values which go beyond the practical. Must we, then, assume that the ideal is of a different nature from the world of fact. By no means. The ideal values are created in periods of great excitement, such as, for instance, the Renaissance and the French Revolution, when life for a time turns aside from the merely useful. Whilst the intenser life of such periods must of necessity soon die down, the judgments of value and the ideals they create survive into the periods of greater tranquillity, and it is from this that the apparent contradiction between the ideal and world of fact is born.

Prof. Ostwald, the exponent of "energetics," put forward a curious hypothesis in his paper "La Volonté et sa base physique" on the connection between the second law of thermodynamics and the mental phenomena of will. He started from general considerations drawn from Comté's and his own classification of the sciences. The notion of the antecedent and more general sciences finds a regular and systematic application in the subsequent and more special ones, while at the same time these latter require, in addition, the use of new conceptions. There is, for example, a mathematic and a geometry of chemistry, but not a chemistry of mathematics or a biology of physics. He then examined in this light the conception of energy. It appears for the first time in the domain of the physical sciences, and for that reason, while it has no application in the more general sciences of mathematics and logic, it should play an auxiliary part in biology, psychology, and sociology. The laws of the lower sciences cannot adequately explain the phenomena dealt with by the higher, but they provide the framework inside which the latter must work. How does this work out in detail? What meaning have the laws of energy applied to mental life? Just this—that whatever else mental life is, it has to work inside the limits of the second law of thermodynamics. Each individual is occupied all its life with the task of making circulate through its own body a part of the general course of "free" energy on its way to energy of a lower intensity; and further, as only part of this energy can be usefully employed, the rest being wasted in heat, so whatever else mental life may be it must first be directed towards getting as much out of this dissipation as possible. In the effort to increase this percentage, to save energy, comes, in Ostwald's opinion, the whole phenomena of the will. He does not pretend that the second law is an adequate explanation of all mental process, but it is the conditioning framework inside which all the rest must work. It is the dominating fast of mental life. It is this which makes the tremendous importance of the will. All human activity is devoted to get the most out of this limited energy. (Incidentally, one may note the resemblance to Mach's conception of science as a process of economy of thought.) It is this conception of the "degradation of energy" which forms the basis of all the processes in which Schopenhauer saw manifestations of the fundamental will.

The English element at the congress was very small, being responsible for only eleven papers out of a total of 200. Among these the most important was Dr. Schiller's paper on error, which provoked, as any exposition of pragmatism always does at these meetings, a most lively discussion. There was also a paper by E. S. Russell on vitalism, and an interesting little note by Miss Constance Jones sketching out a new law of thought, which attempted to lead logic out of the barrenness of the law of identity, and which she enunciated in the phrase "Every subject of predication is an identity (of denotation) in diversity (of intension)."

The next congress will be held in London in 1915, under the auspices of the University, and it is hoped that this will create a greater interest in these meetings than has heretofore been the case in this country.

RESEARCH AT THE NATIONAL PHYSICAL LABORATORY.[1]

THE representative character of the work done at the National Physical Laboratory is well shown by the eight papers in the volume before us.

Nos. 1 and 2 are by Dr. Chree, and are entitled "Some Phenomena of Magnetic Disturbances at Kew" and "Discussion of Results Obtained at Kew Observatory with an Elster and Geitel Electrical Dissipation Apparatus from 1907–9."

No. 3 is the ninth report to the Alloys Research Committee of the Institution of Mechanical Engineers, on "The Properties of Some Alloys of Copper, Aluminium, and Manganese," by Messrs. Rosenhain and Lantsberry. This is a voluminous paper, and occupies more than half of the entire volume. It is the direct outcome of the eighth alloys research report on the properties of the alloys of copper and aluminium. The study of any ternary system of alloys is a work of considerable magnitude. As the authors remark (p. 65), "If we suppose for the sake of comparison that the study of alloys to the extent of one for every range of 2 per cent. in composition constitutes a sufficiently complete investigation of any system, then in any series of alloys of two metals, such as copper and aluminium, the study of some fifty alloys would meet these requirements, while the corresponding degree of completeness in the case of a ternary system would require the study of no less than 1250 alloys." Very few industrial alloys, however, belong, strictly speaking, to a binary system. The majority are ternary, or even more complicated mixtures, and it is therefore of great industrial importance as well as of scientific interest that the study of such systems as the above should be undertaken.

The authors have not attempted to cover the entire field, but have contented themselves with experimenting on the addition of manganese to the most promising binary mixtures revealed in the eighth alloys report, which are situated at the ends of the system.

At the copper end they have found that certain ternary alloys present advantages over the best binary alloys, these consisting chiefly in a "higher yield point . . . a slightly higher ultimate stress and an undiminished ductility," in the static tests. A hot-rolled bar of a bronze containing approximately 10 per cent. of aluminium and 1 per cent. of manganese gave an ultimate stress of 42 tons per square inch with 30 per cent. elongation. In the dynamic tests, however, there is very little to choose between the binary and ternary systems. Three alloys were found to offer remarkable resistance to abrasion, and in this respect considerably surpassed ordinary tool steel, and as they machine quite readily they might very well be tried in cases where this property is of primary importance, e.g. in the form of turbine blades which have to withstand high velocity steam. As regards constitution, the authors have found that

[1] The National Physical Laboratory: Collected Researches, Vol. VII. 1911, pp. iii + 228.

"within the limits of the alloys studied, the constitution of the ternary alloys very closely resembles that of the binary alloys of aluminium and copper; manganese influences the properties of the alloys in a manner somewhat similar to that of aluminium, but at a different rate."

At the aluminium end the results have been less favourable. The most promising alloy appears to be one with 3 per cent. of copper and 1 per cent. of manganese, which in the form of a chill casting gave a tensile strength of 12 tons per square inch and an elongation of 13·5 per cent. on 2 inches. In the form of rolled bars, however, the authors say, "there does not appear to be any advantage in using the ternary alloys as compared with the alloys of aluminium with copper alone."

The remaining papers are as follows:—

(4) "Report on the Progress of the National Experimental Tank," by Dr. R. T. Glazebrook.

(5) "On the use of Mutual Inductometers," by A. Campbell.

(6) "Comparative Life Tests on Glow Lamps," by C. C. Paterson and E. H. Rayner.

(7) "On a Method of Counting the Rulings of a Diffraction Grating," by G. W. Kaye.

(8) "The Expansion and Thermal Hysteresis of Fused Silica," by G. W. Kaye.

In view of the extensive application of fused silica or quartz glass to physical and chemical operations, the last-named paper is of considerable interest. A curve is given from which the mean coefficient of expansion over any desired range between $-190°$ C. and $1100°$ C. may be derived. From this curve it appears that two change-points exist, one at $-80°$ C., the other at about $1000°$ C. As regards linear hysteresis, the author concludes, "Silica over a range of $0°$ C. to $400°$ C. has nothing to fear in comparison with either Invar or Jena thermometry glasses. . . . There is practically nothing to choose between the different kinds of fused silica." A silica standard metre is being completed at the laboratory.

H. C. H. C.

SPECIALISATION IN UNIVERSITY EDUCATION.

THE March issue of *The Johns Hopkins University Circular* contains an account of the celebrations in connection with the Commemoration Day of the University held on February 22. Dr. James Bryce, the British Ambassador to the United States, was the principal speaker, and in his address discussed the tendency to over-specialisation in university education. Mr. R. Brent Keyser, the president of the Board of Trustees, read a statement of the plans for the development of the new site for the University. Nine years ago, he said, at the time of the raising of the Million Dollar Endowment Fund of 1902, the University received also the gift of the Homewood property. This property, under the deed of gift, is to become the permanent home of the University when, in the judgment of the Board of Trustees, the interest and welfare of the University permit. A plan for development has been provided which will admit of growth and alteration to suit the changing needs of future years. To-day we have been given, he continued, means to accept the offer of 50,000*l*. from the General Education Board, and the total amount pledged, part of it already paid in, amounts to nearly 240,000*l*. With great wisdom, the General Education Board, the aim of which is to help the cause of education of the whole country, has provided that at least 100,000*l*. of this amount shall be retained as a permanent endowment, the income only to be used, so that the institution might not be crippled in its real work by the expenditures incident to large building operations, and by the greatly increased expense which will come from living in such an enlarged environment.

Mr. B. H. Griswold, jun., chairman of the committee on the endowment and extension fund of 1910, said 1500 gifts, ranging from one dollar to 20,000*l*., totalling nearly 240,000*l*., and substantially every dollar of it from Maryland, with the exception of the gift of the General Education Board and contributions of non-resident alumni, had been secured. Apart from the original gift of the founder and apart from all legacies, the citizens of Maryland and the alumni of the University, before the last appeal was made and answered, had bestowed, by direct gift, upon the University since its foundation more than 600,000*l*. The exact amount contributed to date to the 1910 Endowment and Extension Fund is 238,635*l*. Of this sum, 50,000*l*. was given by the General Education Board, 48,000*l*. by the trustees of the University, 60,000*l*. was subscribed by the alumni, and the balance of more than 80,000*l*. was given by those to whom we have given the simple but honourable degree of "Friends of the University." A few special gifts may be mentioned: there is one of 4000*l*. to the department of romance languages, one of 2000*l*. for the Edmund Law Rogers fellowship, and 2000*l*. for the Hutzler library.

Mr. Bryce's address applies equally to British as to American universities, and it is here reprinted in an abridged form.

A remarkable feature of the thirty-five years over which we look back is the wonderful development of the various departments of human knowledge, and especially those which are concerned with the sciences of nature, into special branches, each of which has been tending to become more distinct from the others. So far from finding ourselves approaching the end of human knowledge, we find that the more we know the more remains beyond to be known, and that the realm of the unknown seems to be always increasing with every addition to our knowledge. It is as though the path which we are following were always diverging into a number of different paths which tend to separate from one another, and lead us into untrodden solitudes to which we see no end. Within the recollection of most of us, new branches of science have made good their place, and have become recognised as separate fields of inquiry, and along with this it has befallen that the great majority of scientific inquirers now, so soon as their general scientific education has been completed, begin to devote themselves to one particular branch of investigation and throw their whole energy into pushing it forward. A man is now not a "natural philosopher" in the old sense of the term, but belongs to some one of the specific branches into which natural philosophy has become divided. The same thing has happened in those practical arts which depend upon the application of science. They, too, have multiplied by division, and thus new practical professions have grown up, which were scarcely thought of forty years ago.

The same thing has of necessity happened in university education. We have now in all organised universities professors of a large number of distinct branches of knowledge, which were formerly lumped together as being one branch under one professor.

So also among the students the tendency is for those who have advanced some way to begin to devote themselves to one particular line of study and investigation. Both the teacher and the student are naturally fascinated by the prospect of discovery. The professor likes best to lecture upon the subject in which he is pushing forward his own investigations, and the student is able to find in them the most attractive field of experimental research.

This sort of specialisation has become inevitable, but there is a consequence attached to it which has seemed almost equally inevitable, namely, that part of the time which was previously given to general study, to a knowledge both of natural science in general and of other subjects, has now had to be devoted to this special study. The field of nature is unlimited. Human curiosity is unlimited. But human life and the capacity for using our time and our powers in the acquisition of knowledge remain within very narrow bounds.

Accordingly, the problem which to-day confronts us in all universities is how to find time both for these specialised studies, which have become so much more absorbing, and also for a survey and comprehension of the general field of human knowledge which is necessary in order to make the university graduate a truly educated and cultivated man, capable of seeing the relations of his own particular study to others and of appreciating the various methods by which discovery is prosecuted. This problem of reconciling special with general study, although most urgent in the sciences of nature, shows itself in what may be called the human subjects also.

However, the difficulty I am referring to arises chiefly

in the sciences of nature. These are now tending to overshadow all other studies, partly perhaps because the practical applications to which they are turned have become very numerous and of immense industrial importance for men and nations, and partly also because we are all fascinated by the progress of discovery, and are so eager to attain certitude that we are disposed to turn from those inquiries in which complete certitude is unattainable to those in which we can find an absolutely firm basis in the laws of nature; and it is in the natural sciences that the subdivision and specialisation of which I have been speaking has gone furthest.

Accordingly, the problem to which I have referred has two aspects. It raises the question of a mastery of the principles of the sciences of nature in general as against a highly specialised study of some one department in those sciences. It also raises the question of the respective claims of the study of physical science, or some branch of it, as against the claims of what may be called the human sciences, or, if you prefer it, human subjects.

What do we mean by general intellectual cultivation as opposed to special knowledge? Without attempting a complete definition—nothing is more dangerous than a definition—I will suggest a description. We mean such a knowledge of the main facts and distinctive methods of various branches of human knowledge as give a general idea of the relations of each branch to other branches, that is to say, of what truth and certitude mean in different departments of study, and what are the various paths by which truth may be reached or approached. If you asked me to indicate what this would include, I should make some such answer as this. In the sphere of natural science, it would include a knowledge, not necessarily wide, but sound and exact so far as it went, of some deductive science such as geometry, and of some science of observation such as a branch of natural history, geology, for instance, or some department of biology, or of such a science as chemistry. On the human side, it would include a knowledge of one of what may be called the abstract subjects, such as psychology or logic or ethics, and of one of the observational subjects such as economics or politics. It would include a knowledge of the principles of language, and of at least one foreign tongue, ancient or modern, preferably an inflected tongue; and, finally, it must include the record of human effort and development through the past, that is, history, which shows us how man has grown from what he was in the past to be what he is in the present, and holds out hopes of what he may be in the future. Without at least an elementary knowledge of these, no man is properly equipped for a life of study and thought, or for those branches of practical life which require a wide intellectual outlook. It is not necessary to-day, as it would have been fifty years ago, to argue that every educated man should have some knowledge of deductive science and of the observational and experimental sciences of nature.

Specialisation is not only inevitable for the progress of discovery, but in many minor ways excellent. It is a splendid thing for a great university like this to have among its professors men, each of whom is abreast of the highest development of some particular line of inquiry and knows how that line of inquiry ought to be prosecuted, so that it holds within its own walls, so to speak, an accumulated mass of various knowledge, representing what the world has yet attained. The scientific specialist makes interesting company—when I have a chance I always try to get beside him at dinner—because he is able to tell us what we seek to know of the progress of discovery in the growing sciences, and we have only to ask him to get at once, without the labour of consulting books, the latest results in the clearest form. The scientific investigator, moreover, seems to have, on the whole, the happiest kind of life that is now possible. Does he know how happy he is? Engaged in the discovery of truth, he has for his helpers all others engaged in the same pursuit, and knows that all his labours are working towards a noble and useful end. He is free from the vexations that beset the business man or the lawyer or the politician. If he has not a happy life, granted good health, it is probably his own fault, for what is finer than to be, as Bacon says, *minister et interpres naturae*?

Admitting all this, and much more that might be said on behalf of specialisation, it is nevertheless right to present to you some dangers that seem to arise from the immense extension of the specialising tendency and from the predominance, in particular, of the study of the natural sciences to the exclusion of other subjects. The phenomena of nature may no doubt be slowly changing, and as we know that even among those bodies which we call the fixed stars the positions of the stars towards one another alter, so oxygen and hydrogen may be different now from what they once were, and the proportion of the elements in the compound bodies may alter. The sciences of nature are occupied with that which is permanent and unchangeable. They deal with those laws which we believe, so far as our knowledge goes, to be immutable, to have been operative in the past, and likely to be operative in the future, as they are operative now. He who is entirely occupied in studying these unchanging laws does not learn thereby how to deal with that which is mutable and transient. But the mutable and the transient include, not only most of what concerns our daily life, but the whole immense field of knowledge which covers the human subjects. The realm of ideas, beliefs, theories, feelings, institutions, habits, in fact the whole realm of human thought and conduct, belongs to the sphere of the transitory and changeable. In investigating this realm, we have to walk by methods which are not only not the same, but are even more difficult than those which belong to the sciences of nature. The investigation of probability is more perplexing and less satisfying than those inquiries at the end of which stands certain and immutable truth. Those who try to apply the same formulæ and methods to the human subjects which they apply to nature are in danger of failing, as Herbert Spencer, for instance, failed when he entered the field of history and that of political or social phenomena.

Sixty years ago people complained, and complained justly, of the narrowness of those, even of some eminent men, who had been trained entirely on the old scheme of education, which largely consisted in grammatical studies, and especially in a knowledge of the ancient languages. Men otherwise highly gifted and instructed who had been so trained often failed to appreciate the interest and value of the study of nature, and showed a strange incapacity to understand its methods. Francis Bacon has warned us against that absorption in a particular set of ideas, that prepossession in favour of one particular view which he classes among the *Idola Specus*, the phantasms of the cave which surround the man who sits in the dark recess of his own line of thought unillumined by the light of the broad sky. So now the devotion to any special study, whether in the sphere of natural science or not, tends to narrow the mind and prevents the faculties from attaining their highest development. Many of the greatest discoveries have arisen from bringing together facts and ideas drawn from different regions the relations of which had not previously been discerned. The more you extend the range of knowledge, the more you increase the chances of such discoveries. Most of the great men to whom the progress of science is due were not trained as specialists, but had minds that ranged far and wide over the field of knowledge.

Someone has said that the chief end of education is to stimulate curiosity, to make a man ask about all things familiar or unfamiliar, the how and the why, to discover matter for inquiry in things which other people have passed over without thinking of the problems they suggest, to retain that activity and versatility and freshness which are the most characteristic marks of a forceful and creative intellect. Is it not wonderful how many things were overlooked in the past which now we feel to need investigation, and may there not be things now that ought to be investigated which we are passing over as familiar? The ancients must have noticed the difference in the aspect and structure of different kinds of rock, for instance. The differences between gneiss and limestone, between basalt and slate, stared them in the face. They saw fossil shells in the strata. But it did not occur to them to seek the explanation of these things, and geological science is not yet two centuries old. The wider the range of a man's interests, the more susceptible he is to ideas of many

kinds, the greater is the pleasure which life can afford him, the better can he contribute to the progress of the world both by stimulating others and by himself pointing out the way in which advances can be made. A university has to think, not only of forming specialists, but of making these specialists better by giving them a wide range of knowledge, and still more of sending out men who sustain the level of taste and insight in the whole community and are fit to be its intellectual leaders.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A public meeting under the auspices of the University Eugenics Society will be held in the new lecture-room, Emmanuel College, by permission of the master and fellows of the college, on Monday, May 22, at 8.30 p.m. The Rev. Prof. Inge, D.D., Dean Designate of St. Paul's, will give an address on "Some Social and Religious Aspects of Eugenics."

OXFORD.—The preamble of the Statute exempting students in natural science and mathematics from examination in Greek passed Congregation on May 16 by 156 to 79.

LONDON.—Presentation Day was on Wednesday, May 10. The Chancellor (Lord Rosebery) presided, and an unusually large number of graduates were presented. A precedent was established this year by the presentation of cadets of the Officers' Training Corps who had gained War Office certificates or proceeded to commissions in the Army. The principal's report showed that the total admissions to the University in 1910–11 were 4255, compared with 4053 in the previous year; internal students, 4350, compared with 4185; and total candidates in examinations leading to degrees or diplomas, 12,681, compared with 12,787. The number of degrees or diplomas granted was 1222. Reference was made to extension of university professoriate, following the appointment of a large number of board of advisors. Among individual benefactions during the year, the most important were those of Sir Francis Galton for eugenics (40,000*l.*), Mr. Henry Dixon for scientific investigations (8000*l.*), Dr. Charles Graham for medical and pathological research (33,500*l.*), and Sir Felix Semon for laryngology (1040*l.*). The report also referred to the notable development of student activities—military, athletic, and social. Lord Rosebery, in a short address, appealed for more adequate accommodation for the central premises of the University and for increased financial support from the authorities and city companies.

IT has been decided by the council of Armstrong College, Newcastle-upon-Tyne, to establish a professorship of philosophy at the college, and to appoint an additional demonstrator in physics.

The Lancet announces the appointment, by the Lord President of the Privy Council, of Sir Donald MacAlister, K.C.B., principal of Glasgow University, as his representative on the International Committee for Postgraduate Medical Instruction.

THREE scholarships in naval architecture have been instituted at the University of Liverpool by the General Committee of Lloyd's Register of Shipping. Each scholarship is of the value of 50*l.* a year for three years, and one will be vacant annually. The first election will take place this year.

Two cases of importance to persons taking part in competitive examinations were settled at the Bow Street Police Court on Saturday last. The defendants were tutors at a coaching establishment, and therefore debarred from taking part in the examinations of the Royal Society of Arts. Notwithstanding their ineligibility, they duly competed under assumed names and gained prizes. The Royal Society of Arts, being anxious that their examinations should be inviolate, and to make it clear to all that people are not allowed either by the rules of the society or the law to compete in examinations in a way which is detrimental to other candidates, took action in the matter, and they are to be congratulated on the result, the defendants being found guilty and punished.

ACCORDING to *Science*, at its recent session the legislature of Kansas voted approximately 200,000*l.* for the State Agricultural College at Manhattan for the next biennium. The funds provide for one wing of an agricultural building, with a detached laboratory for the cutting and curing of meats. The first wing of the new building is to cost 25,000*l.* Two more wings are to be added as the money is voted, each complete in itself. The legislature also provided a special fund for various objects, including money for experiments in the western part of the State in cooperation with the Federal Government; for soil surveys, also in cooperation with the United States Government; for experiments in producing improved wheat, corn, and other crops. The college has this year approximately 2500 students, more, it is said, than are enrolled in any similar institution in the world. The cost per student in this institution in 1910 was 21*l.*

WE learn from *The Belfast News-Letter* that the Library and Technical Instruction Committee of Belfast contemplate making a collection of kinematograph films of educational value for public exhibition in that city. Mr. F. C. Forth, the principal of the Technical Institute, a week or two ago gave a very successful introductory demonstration of the advantages of the kinematograph for teaching the character of various operations and movements that students may perhaps never be able to see for themselves, and which are but poorly represented by the simple lantern-slide. Among the films shown there were illustrated metallurgical works, a visit to Niagara Falls, cheese mites, a fresh-water hydra, rotifers, the circulation of protoplasm in the water weed, the circulation of blood in a frog's foot, chameleons feeding, toads fighting, and the development of a flower.

ON July 14 the King will open the new buildings of the University College of North Wales, which have been completed at a cost of about 112,000*l.*, exclusive of the site, which was presented by the citizens of Bangor. Of the total cost, rather under 10,000*l.* remains still to be collected, and the sums already received include 16,800*l.* from Carnarvonshire, 18,350*l.* from London, 1350*l.* from the staff, and 3500*l.* from old students. The quadrangle of buildings, which is flanked on three sides by the classrooms and offices, has been completed on the fourth side by the Great Hall specially presented by Sir Pritchard Jones. The removal of the arts classes to the new buildings has given increased accommodation to the science departments, and among the gainers the agricultural and forestry departments may be noted. That theory and practice are not always inconsistent is evidenced by the large number of prizes secured by the former department at agricultural shows.

THE council of the Institution of Civil Engineers has made arrangements to hold a conference on the subject of the education and training of engineers on June 28 and 29 at the institution. The subject-matter to be discussed at the conference will be dealt with in three groups, namely, general education, scientific training, and practical training. Among other topics which will receive consideration at the meetings may be mentioned:—the extent to which mathematical and scientific subjects should share with other subjects of literate education the attention of schoolboys who intend to enter later the engineering profession; the question of specialised entrance examinations for university and college courses of study in engineering science with a view to the curricula to be followed, and also of the inclusion in the latter of courses in modern languages; the relation of practical training to college study—whether, or to what extent, before, sandwiched, or after its conclusion; the position and uses of engineering laboratories in relation to education at college; the value of a university degree in engineering science in relation to professional competence; the requirements of practical training in works, with the necessary complement of scientific study; practical training in workshops or on works of construction, with special reference to training in the engineer's office; the relation of engineering employers and colleges from the point of view of the practical training of college students; workshop training as a preliminary to practical training in other branches of engineering.

A COMPLIMENTARY banquet to Prof. H. E. Armstrong, F.R.S., took place at the Hotel Cecil on Saturday, May 13. Although intended, in the first instance, to take the form of a demonstration of affectionate regard on the part of his old students, it was soon found necessary to extend the scope of the celebration, which thus became the occasion for one of the largest scientific gatherings of recent years. The toast of the guest of the evening was proposed by the chairman, Prof. W. J. Pope, F.R.S., and was seconded by Mr. Maurice Solomon. The guests included Sir William Crookes, Sir James Dewar, Sir Chas. Lawes, Profs. H. B. Baker, A. Brown, Clowes, Crossley, Divers, Henderson, Kipping, and Wynne, Messrs. W. Barlow, G. T. Beilby, H. T. Brown, Cross, Hall, R. Messel, R. L. Mond, F. B. Power, and J. E. Stead amongst the chemists; engineering was represented by Profs. Perry, Dalby, Mather, and Sumpner; education by Principal Miers, Mr. R. Blair, Dr. J. H. Cowham, Prof. R. A. Gregory, Mr. A. L. Soper, and Mr. C. M. Stuart; law by Mr. W. Phipson Beale, K.C.; and literature by Prof. M. A. Gerothwohl. On two occasions the Chemical Society has met in order to celebrate the jubilee of five of its past presidents, but we believe that only one similar gathering has previously been organised by a group of chemical students in honour of their professor. The success of the enterprise was most gratifying; "Central" students of every year, from the date of the opening of the college to the present day, united with chemists and others from all over the country, to the number of 230, in honouring one whose influence has been felt and valued by an exceptionally wide circle of admirers and friends.

THE following regulations with reference to the newly founded prize in memory of Lord Kelvin have just been issued by the University of Glasgow:—(1) The prize shall consist of a gold medal of the value of 10*l.*, together with the balance of the income of the capital fund accumulated during three years. (2) The adjudicators shall be the principal, the professor of natural philosophy, and the professor of mathematics. (3) The prize shall be awarded by the Senatus, on the recommendation of the adjudicators, at intervals of three years (the first period beginning with 1911) to the author of a thesis or published work in natural philosophy, including therein mathematical and experimental physics, which has been submitted and approved for the degree of Doctor of Science during the period, and which gives evidence of original research worthy in the opinion of the adjudicators of this special distinction. (4) In making their recommendation, the adjudicators shall have regard to the written reports presented to the faculty of science by the examiners and additional examiners appointed under Section X. of University Court Ordinance No. XXVI. (5) Not more than one award shall be made in each period of three years, and the prize shall not be divided. The adjudicators may, if they think fit, recommend that for a particular period of three years no award be made, and, in that case, the income of the prize shall be added to the capital fund. (6) The Kelvin prize and the William Jack prize shall not be awarded to the same person. (7) After the year 1920 the regulations may from time to time be modified by the Senatus, with the approval of the University Court, provided always that the prize shall continue to be awarded to graduates of the University for special distinction in original research relating to mathematical and experimental physics.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 11.—Sir Archibald Geikie, K.C.B. president, in the chair.—C. T. R. **Wilson**: A method of making visible the paths of ionising particles through a gas. The paths are made visible by condensing water upon the ions immediately after their liberation, an expansion apparatus being used which works without appreciable stirring up of the air. The trails of ions formed by the α particles from radium have in this way been made visible and photographed, very dense and sharply defined rays of cloud being formed on expansion. Air exposed to β rays gives clouds consisting mainly of faint straight threads radiating from the source; these have not yet been photographed. In air exposed to γ rays, the cloud is again in the form of straight threads traversing the cloud chamber—the tracks of β particles from the walls. The cloud formed in air exposed to Röntgen rays is entirely concentrated in minute streaks and patches. A photograph shows these to consist mainly of fine threads not exceeding a few mm. in length, and generally far from straight, probably the tracks of kathode rays produced in the air by the X-rays. The whole of the ionisation would appear, as Bragg has already suggested, to be effected by the kathode rays derived from the X-rays.—W. H. **Dines**: The vertical temperature distribution in the atmosphere over England, and some remarks on the general and local circulation. This paper gives an account of the results of some 200 observations made in the British Isles in the years 1908, 1909, and 1910 on the temperature of the upper air. It discusses the annual variation of the temperature up to 14 kilometres, and shows that the annual range remains fairly steady, with a total amplitude of about 12° C. up to 11 km., above which the range suddenly drops to 3°, and the times of the maxima and minima go back two months. The question of the daily variation at great heights is then discussed. The relation between the temperature at various heights and the height of the barometer at the surface is dealt with, and it is shown how over a low-pressure area with the barometer below 740 mm. the temperature of the first 8 km. is very low, reaching at 7 km. a value of nearly 10° C. below its average value, and that above 10 km. it is considerably above the average. In the anti-cyclonic parts the conditions are reversed, and it is warm below and cold above. The height at which the isothermal region is met with in summer and winter and in times of high and low barometer is then referred to. A statement with regard to the existence of similar conditions that have been found to exist on the Continent is also given. In the second part of the paper various theoretical considerations are taken into account. It is shown that if an extensive and strong wind exists in any part of the atmosphere, warm air will be found somewhat below it on its right hand, and cold air above it on the right, with converse conditions on the left, and it is pointed out that this agrees with the distribution of temperature that is found to exist at the various levels of cyclones and anticyclones.—Prof. W. N. **Hartley**: Some mineral constituents of a dusty atmosphere.—Dr. H. Stanley **Allen**: The path of an electron in combined radial magnetic and electric fields. The path of an electron in a radial electric field superposed on a radial magnetic field is found to lie on a circular cone the vertex of which coincides with the magnetic pole. If the surface of the cone is developed into a plane, the trace of the path is a conic section with the vertex as focus. The solution in the particular case in which there is no electric field has been given by Poincaré; the path is then a geodesic line on the surface of the cone, and, of course, becomes a straight line when the cone is developed. In cases which can be realised experimentally, the developed path is hyperbolic, and does not in general differ greatly from a straight line. An account is given of some experiments carried out to illustrate the theory. The first observations were made with a focus tube in which the antikathode was the pole of an electromagnet. The phenomena observed are easily explained in terms of the theory. Other vacuum tubes were prepared in which a fine pencil of kathode rays could be produced by means of a Wehnelt kathode. In a radial magnetic field the stream of electrons assumed a spiral form, and a number of photographs were obtained showing the spiral paths on a cone of revolution.—Dr. R. A. **Houstoun**: The absolute measurement of light—a proposal for an ultimate light standard. A thermopile cannot be used for the measurement of candle-power, because it gives the same value to the energy of every wave-length, invisible as well as visible. The author has, however, found by spectrophotometric investigation in the ultra-violet, visible, and infra-red parts of the spectrum that if a filter consisting of aqueous solutions of copper sulphate and potassium bichromate in a particular strength in glass cells be placed before the thermopile, then this filter stops the ultra-violet and infra-red entirely, and lets through a fraction of each wave-length in the visible spectrum pro-

portional to its visibility. In other words, it weights each radiation according to its visibility. The voltage on a tantalum lamp was varied over a wide range, and its candle-power as read by thermopile and filters agreed well with the readings of a photometer. Owing to the high sensitiveness of the galvanometer required, the method is not suitable for commercial application, except perhaps for integration photometry, when a number of thermopiles might be connected in series with the one galvanometer. The importance of the method lies in the fact that it provides a satisfactory basis for heterochromatic photometry independent of the Purkinje phenomenon at all intensities. The author therefore proposes to use it for defining the unit of light intensity. He would define the latter as that source, the total intensity of radiation from which at a distance of 1 metre after passing through his filters would be x ergs/sq. cm., sec. For the standard candle x should be about 0·8.—Prof. A. C. **Dixon**: Harmonic expansions.

Royal Microscopical Society, April 19.—Mr. H. G. Plimmer, F.R.S., in the chair.—E. J. **Spitta**: Low-power photomicrography, with special reference to colouring methods.—E. J. **Spitta**: Report on Grayson's rulings.—E. J. **Shepherd**: The reappearance of the nucleolus in mitosis. This was an addendum to the author's previous paper, communicated in April, 1909, on the disappearance of the nucleolus in mitosis. In the present communication the author said that with a view to ascertain how and when the nucleolus makes its reappearance, the diaster stage is the one which calls for most careful study and observation. At or about the time of the formation of the dispirem, and before the diasters have lost their characteristic shape, a looping in the chromatin is observed, the number of loops varying in each daughter nucleus. It is in these loops that the nucleoli will appear, but it must not be inferred that a nucleolus will appear in each loop, as there are frequently more loops than nucleoli. The latter make their appearance when the division of the cell is well marked, and when the interzonal fibres have generally disappeared. From the results of his research, the author was of opinion that the nucleolus is a product of the chromatin injected into the loops by a process which can best be described as a "streaming in" process. A full account of the technique of staining and methods adopted, &c., which have led to the above conclusion, will be found in The Journal of the Royal Microscopical Society.—J. **Murray**: Second portion of a report from the Shackleton Antarctic Expedition of 1909 on the Canadian rotifera. Forty-two species (all bedlloids) were collected among mosses. They included five new species, *Callidina asperula*, *C. canadensis*, *Mniobia obtusicornis*, *M. montium*, and *Harbrotrocha maculata*. There were also a number of peculiar varieties of other species. *Callidina asperula* has since been found in Ireland by the Clare Island Survey. Twenty-seven bedlloids were previously recorded for the United States. Six of these occurred in their collections, so that the number of bedlloids now known in North America stands at sixty-three species, but a number of these were of doubtful value. Among the rarer Canadian species were *Philodina australis* (Australia and Canada), *Callidina speciosa* (British Guiana and Canada), *C. zickendrahti* (Russia and Canada).—Señor Domingo **de Oureta**: A new piece of apparatus for photomicrography, with the microscope in the inclined position.

Geological Society, April 26.—Prof. W. W. Watts, F.R.S., vice-president, in the chair.—A. **Wade**: The Llandovery and associated rocks of north-eastern Montgomeryshire. The area dealt with is near Welshpool, and comprises part of the Severn Valley and the whole of the Vale of Guilsfield. In the succession worked out, the Ashgillian and the Valentian are distinguished for the first time, while the distinction between the Wenlock and the Ludlow beds is brought out by means of graptolite zones. The stratigraphical succession is shown by traverses. The district is shown to be transitional in character between neighbouring districts on almost every side. The structure of the area is that of an anticline with "keystone" faulting. The two boundary-faults of the arch have considerable downthrows. An account is given of the Welshpool Dyke. The glacial geology of the area is described, three series of deposits being observed:—(1) a high-level series; (2) a low-level series; and (3) a stratified series. The Guilsfield Valley is shown to have been occupied by a glacial lake, and the reversed drainage of the Cefn-Yspn Brook is shown to be connected with a "col" through which the overflow water drained.—Dr. J. D. **Falconer**: Geology of northern Nigeria. The protectorate covers an area of about 255,000 square miles, over half of which crystalline rocks are exposed at the surface. Hard, banded gneisses of an Archæan type are intermingled with quartzites, phyllites, schists, and gneisses of sedimentary origin, so as to suggest that the two series, while originally unconformable, have been later affected by a common folding and foliation along axes predominantly meridional in direction. The two series have also been pierced by igneous intrusions of a granitic type. Folded and faulted rocks of Cretaceous age are found. These Cretaceous rocks are overlain unconformably by a horizontal series of sandstones, grits, conglomerates, and ironstones, which in Sokoto province contains intercalations of Middle Eocene limestone. Volcanic activity occurred during Tertiary times, and gave rise to fields of basaltic lava in Bauchi and Bornu, as also to numerous puys of trachyte, phonolite, olivine-basalt, and nepheline-basalt throughout southern Bauchi, Muri, and Yola. Repeated minor oscillations during the latter part of the Tertiary era culminated in the elevation of the Bauchi plateau, the depression of the Chad area, and the establishment of the present river-system.

PARIS.

Academy of Sciences, May 1.—M. Armand Gautier in the chair.—B. **Baillaud**: Remarks on the "Annales de l'Observatoire de Paris" containing the observations made in 1892.—P. **Villard** and H. **Abraham**: A direct-reading electrostatic voltmeter for very high potentials. A simplified voltmeter capable of giving accurate readings up to potentials of 300,000 volts.—E. L. **Bouvier**: The Pycnogonides of the *Pourquoi Pas?* This group is well represented in the Antarctic regions, more species being found there than in the Arctic regions.—M. **Jarry-Desloges**: *Résumé* of the physical observations of the planet Mars made in the opposition 1909–10, with remarks on the quality of the telescopic images in various regions. The appearance and disappearance of the white polar cap corresponds with a fixed Martian date. No regularity, however, can be traced as regards the changes in form and shade of the dark spots, which, especially in the equatorial regions, do not appear to be related to the seasons. No evidence could be obtained of the existence of a liquid state resulting from the disappearance of the white polar substance.—Jules **Drach**: Determination of the lines of curvature of the Fresnel wave surface.—J. **Hadamard**: The fundamental solution of partial differential equations of the parabolic type.—L. **Godeaux**: Linear congruences of conics.—MM. **Claude**, **Ferrié**, and **Driencourt**: Radio-telegraphic comparisons of chronometers by the method of coincidences between Paris and Bizerta. It has been definitely established by these experiments that radio-telegraphic comparisons by the method of coincidences are capable of giving the difference of time between two chronometers 1000 miles apart, and with an accuracy of at least 0·01 sec.—C. **Raveau**: Interference fringes from a linear source of light.—M. **Estanave**: Photographs with changing colours. A description of a method of obtaining a photograph the colours of which change according to the angle of observation.—M. **Aubert**: Thermo-diffusion.—Walter **König**: The displacement of ultramicroscopic particles produced by very rapid sound shocks. A theoretical explanation of some experimental results recently described by MM. Henri and Lifschitz.—M. **Pomey**: The propagation on a telegraph line of the current due to a constant electromotive force.—Jean **Perrin**: The determinations of molecular magnitudes. A criticism of several methods based on Stokes's law. For the charge of the electron, the value $4·24 \times 10^{-10}$ is regarded as more probable than the usually accepted $4·8 \times 10^{-10}$.—Jules **Roux**: The charge of the electron. Determinations on sulphur particles lead to the value $4·17 \times 10^{-10}$.—A. **Blanc**: The ionisation produced by phosphorus.—Georges **Moreau**: The ionisation of salt vapours by a corpuscular radiation.—F. **Leprince-Ringuet**: Study

of the state of insulation of an alternating network by means of voltmeters interposed between a pole and the earth.—Jacques **Duclaux**: The application of the kinetic theory to the study of the phenomena of catalysis.—Œchsner **de Coninck**: Determination of the molecular weight of uranyl, UrO_2. The reduction of H_2UrO_4 by pure hydrogen at a red heat led to a molecular weight of 270·66 for UrO_2, as against 270·5 deduced from the atomic weight 238·5 for uranium.—H. **Henriot** and M. **Bouyssy**: A method for measuring the impurities in a confined atmosphere. Metallic vessels containing a freezing mixture of ice and salt were suspended in the room, the ice being melted and weighed. The amount of reduction of a solution of potassium permanganate and chromic acid was determined, and this taken as a measure of the impurity of the atmosphere.—MM. **Taurel** and **Griffet**: The determination of the proportion of combined sulphur in a mixture of different forms of sulphur.—Frédéric **Aronssohn**: The mineral composition of the bee. Fifteen elements were determinable in the ash, including arsenic, copper, manganese, and zinc.—Jean **Pougnet**: The action of the ultra-violet rays upon the green pods of vanilla. Ultra-violet light produces the odour of vanilla in fresh green pods; manganese salts accelerate this action.—Lucien **Daniel**: Biometrical researches on a graft hybrid between the pear and quince trees. After six years' cultivation, no flowers have been produced on this hybrid. A study of the leaf dentition shows the influence exerted by the subject on the graft.—A. **Marie** and Léon **MacAuliffe**: The height and general morphology of French women.—MM. **Landsteiner, Levaditi,** and **Prasek**: Attempts to transmit scarlatina to the chimpanzee.—C. **Vaney** and G. **Tainturier**: The degenerescence of some larval forms of *Hypoderma bovis*.—Carl **Störmer**: The results of photogrammetric measurements of the altitude of the aurora borealis at Bosekop during February and March, 1910.

MELBOURNE.

Royal Society of Victoria, March 9.—Prof. E. W. Skeats, in the chair.—J. **Mann**: Papuan timbers, some of the properties of six species. These, known as Ulabo, Tamanau, Alaga, Madave, Kokoilo, and Ilimo, are now being exported. Mechanical tests for strength, and for calorific value, charcoal, and ash were made, and the results are tabulated. Ulabo, which is a dark heavy wood, is of engineering value and white-ant proof, while the others are useful for general joinery and, being well coloured and figured, for cabinet work.

DIARY OF SOCIETIES.

THURSDAY, MAY 18.

ROYAL SOCIETY, at 4.30.—The Properties of Colloidal Systems. II. On Adsorption as Preliminary to Chemical Reaction: Prof. W. M. Bayliss, F.R.S.—Inbreeding in a Simple Mendelian Stable Population, with Special Reference to Cousin Marriage: S. M. Jacob.—On the Direct Guaiacum Reaction given by Plant Extracts: Miss M. Wheldale.—Transmission of Amakebe by means of *Rhipicephalus appendiculatus*, the Brown Tick: Dr. A. Theiler.—On Distribution and Action of Soluble Substances in Frogs deprived of their Circulatory Apparatus: S. J. Meltzer.—The Discrimination of Colour: Dr. F. W. Edridge-Green.

ROYAL INSTITUTION, at 3.—Air and the Flying Machine. I. The Structure of the Atmosphere and the Texture of Air Currents: Dr. W. N. Shaw, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Principles of the Construction of Vegetation Maps: Dr. C. E. Moss.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Telephone Exchange Systems: W. Aitken.

FRIDAY, MAY 19.

ROYAL INSTITUTION, at 9.—Recent Experiments with Invisible Light: Prof. R. W. Wood.

SATURDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Phases of Bird Life. I. Flight: W. P. Pycraft.

MONDAY, MAY 22.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 8.—Rock Crystal: its Structure and Uses: Dr. Alfred E. H. Tutton, F.R.S.

TUESDAY, MAY 23.

ROYAL INSTITUTION, at 3.—The Brain and the Hand: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Classification of the Prehistoric Remains of Eastern Essex: S. Hazzledine Warren.—On a Prehistoric Skeleton from Walton-on-Naze: Dr. A. Keith.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—Recent Advances in Gas Thermometry: Dr. A. L. Day.—The High Temperature Equipment at the National Physical Laboratory: Dr. J. A. Harker, F.R.S.—The Boiling Points of Metals: H. C. Greenwood.—The Behaviour of Silica at High Temperatures: A. Blackie.—On the Maintenance of Constant High Temperatures: Prof. Bodenstein.—On Stellar Pyrometry: M. Fery.

WEDNESDAY, MAY 24.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 8.—Architecture in America: Frank M. Andrews (New York).

GEOLOGICAL SOCIETY, at 8.—On the Geology of Antigua and other West Indian Islands, with reference to the Physical History of the Caribbean Region: R. J. Lechmere Guppy.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Milk: H. Droop Richmond.—Notes on the Analysis of Margarine: Cecil H. Cribb and P. A. Ellis Richards.—Observations on some Methods of Estimating Cocoanut Oil and Butter in Butter and Margarine: Cecil Revis and E. Richards Bolton.—The Estimation of Quinine as the Acid Citrate, in certain Organic Liquids: T Cockburn and J. W. Black.—The Determination of the Amount of Dissolved Oxygen absorbed by Sewage Effluents containing Nitrite, and of the Amount of Nitrite in Sewage Effluents or Water: R. W. Clarke.—Further Analyses of Ghee: Cecil Revis and E. Richards Bolton.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experiments on the Compression of Liquids at High Pressures: Hon. C. A. Parsons, F.R.S., and S. S. Cook.—An Optical Method of Measuring Vapour Pressures; Vapour Pressure nnd Apparent Superheating of Solid Bromine: C. Cuthbertson and Mrs. M. Cuthbertson.—The Vacuum-tube Spectra of Mercury: Dr. F. Horton.—The Production of Characteristic Röntgen Radiations: R. Whiddington.

ROYAL INSTITUTION, at 3.—Air and the Flying Machine. II. Conditions of Safety for Floaters and Fliers: Dr. W. N. Shaw, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—N.W.F. Province of India: W. R. H. Merk.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Phases of Bird Life. II. Migration: W. P. Pycraft.

ARISTOTELIAN SOCIETY (at Oxford in conjunction with Mind Association).—A Symposium on the Relation of Psychology to Metaphysics: G. F. Stout and A. Smith.

CONTENTS.

THURSDAY, MAY 25, 1911.

MENDELISM AND BIOLOGY.

Mendel's Principles of Heredity. By W. Bateson, F.R.S. Pp. xiv+396. (Cambridge: University Press, 1909.) Price 12*s.* net.

THE time has come when a preliminary attempt may be made to forecast the position which Mendel's discovery will occupy in the history of biology, and when the widely divergent attitudes which have been taken up towards Mendelian principles may be profitably considered.

The reviewer is in the present case relieved of the duty, which usually falls to his lot, of indicating the nature, scope, and value of the contents of the book before him; for, whether we agree with Mr. Bateson or not, sceptics and adherents alike consider that his book is the fullest and most authoritative exposition of the results which have been achieved by those who have worked on the lines laid down by Mendel. These results may throw no light on the nature of heredity or on any problem which it has pleased the imagination of biologists to invent; but, be this as it may, the book before us is the source from which the fullest and most trustworthy information in regard to these results is to be sought, and no attention need be paid to the criticisms of those who are not intimate with its contents. Whatever the Mendelian doctrine is, here it is, for better or for worse.

To estimate the significance of this book we must, therefore, assign this doctrine to a place in the scheme of biology. The degree of success which will attend the efforts of any given person to perform this task will be inversely proportional to the faculty possessed bv him of imagining that he may be mistaken. If he lacks this faculty altogether, complete success, so far as he is concerned, is assured, and the Mendelian hypotheses will either be set down as the correct picture, drawn now finally, once and for all, of the hereditary processes underlying the phenomena which they were invented to explain, or as the fantastic imaginings of unfortunate biologists who are unwilling or unable to take the whole of the available evidence into account. To us, who foster and preserve some of the attributes of childhood, these two extreme views appear no more than naïve and elementary, the utterances of men who, in the current phrase, "know their own minds." We cannot believe that in every department of the Mendelian hypothesis the explanation offered does more than approximate to that picture of the underlying processes which will ultimately be agreed upon as representing them as accurately as they ever can be represented. Still less can we believe that the Mendelian hypothesis is wide of the mark altogether, and bears no relation at all to the phenomena which it attempts to explain. How true a representation it is, can only be determined by subjecting its component hypotheses to rigorous experimental tests. Our own opinion, to which, however, we attach little weight, inasmuch as the experiments designed by us to effect this test are only, as yet, begun, is that the majority of the hypotheses will stand these tests well.

We may now pass from the question as to the truth of the Mendelian principles to that of the bearing of these principles on those products of the imagination which we agree to name "great biological problems," such, for instance, as the "nature of heredity" and the "origin of species." The former question must, we suppose, be regarded as a real one, but, of course, not one any answer to which will ever be regarded as the final one. But the latter involves so many notions, only remotely representing phenomena, and so many generalisations which are manifestly *interim* ones, that the discussion of its relation to Mendelian principles becomes a mere exercise in dialectic offering no prospect of ever so slight a progression in the direction of a clearer vision of actuality.

Let us deal first with heredity. The problems of heredity which are debated at the present day exist only for those who adopt that view of life which insists on the disparateness and circumscription of the units to the succession of which the continuation of the stream of life is due. To those, on the other hand, who think that the cutting up of this stream into individuals (which, so far as we can see at present, do certainly appear to be discreet) is an unwarrantable insistence on a secondary feature; and who think that the difference as regards the livingness of the objects of their several interests between a man who is not satisfied with observing less than, say, ten consecutive generations of a living thing and a man who dissects a rabbit, is as great as, and of the same nature as, the difference between a man who dissects a rabbit and a man who collects stamps —to these the favourite problems of heredity do not exist at all, though the material out of which these problems have been constructed is the chief object of their attention.

With regard to the light thrown by Mendelian results on the question of the origin of species. The idea that the process of specific differentiation is akin to that of Mendelian segregation will doubtless serve as a fertile incentive to investigation for years to come. But to suppose that evolution is due to causes which can be compared to the shuffling of marbles in bags seems to us to be an idea which throws no light on any problem, save on that of the value of the insight of those who are not ashamed to confess that they entertain it.

The strictly phenomenal or impressionist aspect of specific differentiation must be attacked by means of the instrument which Mendel has put into the hand of biologists—the analysis of the organism into its constituent characters by experimental breeding. But to suppose that the Mendelian method does any more than indicate the lines along which the attack on this particular problem is to be made betrays, in those who make this supposition, a high degree of that naïve sanguineness as to the powers of the human intelligence which constitutes, at the present day, the most formidable obstacle blocking our approach to a true vision of life and evolution.

O

BRITISH MARINE WORMS.

Ray Society: A Monograph of the British Annelids. By Prof. W. C. McIntosh, F.R.S. Vol. ii., part ii. Polychæta. Syllidæ to Ariciidæ. Pp. 233–524+23 plates. (London: Dulau and Co., Ltd., 1910.) Price 25*s.* net.

THIS volume constitutes a further instalment of Prof. McIntosh's large monograph of British Polychæts, and its publication raises the hope that the entire work will be completed in a few years. The families described are amongst the most interesting and the most familiar to naturalists, yet they have probably never received such detailed treatment as is here accorded, with the result that we now have such a survey as Huxley first planned when he undertook professional work. The variety and beauty of this section of the British fauna will be a surprise to most naturalists.

The most interesting points in the volume are the assumption of the "epitokous" stage among the Nereids, and the phenomenon known as "Palolo."

During their asexual or "atokous" stage, Nereids are provided with similar lobes and bristles on every segment, but when the breeding season ensues many species of this family undergo a metamorphosis. The head and eyes enlarge, the posterior two-thirds of the body grows out segmentally into new lamellar feet, and these in turn develop long swimming bristles. In this "hetero-nereis" or "epitokous" phase, the two sexes often differ in colour and in habits, and in at least one species there are again two castes of males. The behaviour no less than the appearance of these animals now finds a new expression. Up to this period, Nereis has lived a sluggish life in a burrow. Now as hetero-nereis, he or she strikes out for the open sea, swimming easily and gracefully by rhythmical contractions of the paddles, and discharging broadsides of ova or of milt into the water. This effort is probably the final act of a career, for, carried away by the act of discharge, these pelagic Nereids may rupture and die.

On this subject the veteran naturalist of St. Andrews has gathered together his own vast stores of information and also those of his fellow-workers. He traces the development of this metamorphosis in all available instances, and collates a great amount of information, not only as to British, but concerning all Polychæts that exhibit this phenomenon.

With regard to palolo, this Fijian word has reference to a peculiar swarming of Polychæts at the surface of the sea. At Amboina, round Japan, on the coast of Florida and Samoa, swarms of Eunicid worms suddenly appear at definite times and disappear as suddenly as they came. The interest of their advent is increased by its coincidence with a certain phase of the moon in two months of the year, October and November in some places, March and April in others. Several genera exhibit this habit of swarming on two or three definitely fixed nights if the weather be clear. By the following morning not a trace of them is to be seen.

Still more remarkable are the details of the process. During the preceding twelve months these Annelids have led a sedentary life, hiding as far as is known in crannies or burrows in rock and coral. No sooner, however, is the moon at full in March or in October, as the case may be, than these Eunicids turn round in their burrows, twist off their tails, and send them wriggling on to the surface, the head end meanwhile remaining in the burrow. The whole mature population simultaneously perform the act, with the result that the neighbouring water acquires an appearance not unlike that of vermicelli. These severed tail ends are provided with special ocelli, and swim away laden with ova or with milt, which they discharge with every contraction. In a few minutes disruption is complete, and hence by sunrise the act is over. Meanwhile the head-ends, ensconced in their burrows, are already making scar-tissue, and in time regenerate the missing portion.

Such in brief, though, of course, subject to local modifications, is the meaning of this expression, and we now ask is there a British palolo, or have we anything of this nature on our coasts? The monograph before us gives no certain answer. True, there is a British *Lysidice punctata* at Guernsey, closely allied to a species that acts palolo elsewhere, but at present such swarming, if it occurs, has escaped observation. As to this and many other features of habits, coloration, and development, there is still a wide field for research amongst Polychæts. We trust that the publication of this monograph will stimulate to fresh observations on this interesting group.

Rather unwillingly, a word of criticism must be added, and it is to repeat a request made in the review of the preceding section that appeared in this journal in 1908. It was there urged that the family name of each species should be placed as a headline to one of the two facing pages, preferably the left, and we would also ask for an outline classification in each part as issued. For working purposes the absence of these two simple devices creates an extraordinary amount of trouble, and the reviewer is, after careful search, still far from clear as to the classification of, for example, the Eunicidæ.

In conclusion, the magnificent plates of coloured figures reflect the greatest credit on everyone concerned in their production. Plate liii., for instance, representing *Nereis virens* in all its three feet of beauty is a wonderful picture. Prof. McIntosh is to be heartily congratulated on the completion of such a large section of this great work.

F. W. GAMBLE.

CHEMISTRY FOR MINERS.

Elementary Chemistry for Coal-mining Students. By Prof. L. T. O'Shea. Pp. ix+319. (London: Longmans, Green, and Co., 1911.) Price 6*s.* net.

THE object of this little book is to furnish coal-miners with a knowledge of as much of the science of chemistry and of its applications as they are likely to find useful in their everyday work. Its contents are thus naturally divisible into two sections, the first giving an outline of chemical principles, and the second a rather more detailed account of such portions of the subject of coal-mining as depend more especially upon the above principles.

Such a book undoubtedly raises the question whether it is advisable in the interests of the students to lay before them only fragments of a complete science, even though it be admitted that the particular fragments that are most likely to be useful to them in their after-career have been selected with care and discrimination. On one hand, it may be urged that it is better for the coal-miner to have a rudimentary knowledge of chemistry than to have none at all, and that unless the amount of science required of him is cut down to the lowest possible limits, he will have none of it, whilst on the other we have the obvious dangers that attend a limited knowledge of any subject, and in the present case more especially the risk that the man who has mastered such a book as Prof. O'Shea's will think that he has got a real grasp of the science of chemistry and will remain in ignorance of the vast field that this book does not profess even to touch upon. No chemist needs to be told that a book that treats only of the chemistry of certain of the metalloids must necessarily present only a very imperfect outline of the principles of modern chemical science, and there would probably be a pretty general consensus of opinion that, if possible, it would be far better for the mining student to learn the elements of chemistry as an abstract pure science from a book on chemistry, and, having mastered these, then to be taught what portions of that science he has to apply to the problem of his daily work.

Prof. O'Shea has evidently come to the conclusion that the latter method is the less practical, and no doubt there is very much to be said for his view; it must be admitted that the coal-miner who thoroughly masters his little book will benefit greatly thereby, and will certainly obtain a fairly clear understanding of many of the phenomena that he meets with in the pit. The first chapters give an outline of the leading principles of chemical combination, and of the physical and chemical properties of oxygen, nitrogen, air, hydrogen, water, sulphur, carbon, and the oxides of carbon, including a useful chapter on flame and the safety lamp; then follow a number of chapters on the application of the facts thus set forth, on coal, coking, and the recovery of by-products, on explosives, and on gas and dust explosions; the book concludes with some brief chapters on certain chemical and physical calculations, which will prove useful for the proper understanding of certain parts of the subject. Prof. O'Shea has done his work well, and has evidently selected his material with great care and judgment, and with a sound appreciation of the needs and limitations of the coal-miner. He has also taken care to express himself throughout in plain, simple language, and it may be suspected that it is to the desire for simplicity that a certain amount of slipshod writing in the book is due, as, for example, in such expressions as "one of the most improved forms," "a purely dust explosion," &c.; a somewhat flagrant case is the definition of the atomic weight of an element as "a number which represents how much heavier its atom is than the atom of hydrogen," where the author obviously means "how many times as heavy."

It is difficult to see why Prof. O'Shea should insist that nitro-glycerol is the more correct name for nitroglycerine; the latter is a thoroughly well-known and generally accepted trivial name, and if he wants chemical exactitude, he should have used the strictly correct form, glyceryl tri-nitrate; it is now generally recognised that nitro-glycerine and gun-cotton are not, as Prof. O'Shea states, nitro-compounds, but nitrates. In the same way exception may well be taken to the statement that coal occurs in "veins." Such inaccuracies, though they are undoubtedly blemishes in an otherwise very well-written book, do not, of course, detract seriously from its value as a whole, and will presumably be corrected in a future edition. Prof. O'Shea may fairly be congratulated on having produced a little book that gives, within a convenient compass, a great deal of information that will prove extremely useful to all coal-miners, and be found to render very great assistance to the class for which it is more particularly intended. H. L.

ANOTHER BOOK ON EVOLUTION.

Phases of Evolution and Heredity. By Dr. David Berry Hart. Pp. xi+259. (London: Rebman, Ltd., 1910.) Price 5*s.* net.

THIS book is not written by a man red-handed fresh from an encounter with nature. If his hands needed washing before he wrote, it was to remove the dust of books. Would that the water could have removed the taint of much reading also. The notion that the truth must be sought in books is still widely prevalent, and the present dearth of illiterate men constitutes a serious menace to the advancement of knowledge.

The author of this book constitutes an exception to the law that the more certain a man is that he is right the more probable is it that he is wrong. Dr. Hart lays stress on the fallibility of the human intelligence. He realises that he may be mistaken. And he is. The title-page of his book bear these words:

"Every seeker after Truth is dependent on the knowledge of his Age. He must, therefore, shape his coat according to his cloth, and expect a misfit. The words of Cromwell to the General Assembly of the Scottish Church should ever ring in his ears: 'I beseech you, in the bowels of Christ, think it possible you may be mistaken.'"

The book deals with "Mendelism," "Biometry," "Mnemism," "Observation Bee-Hives," "Evolution in Religion," and "Men who have Revealed Themselves."

The obstacles which, according to Dr. Hart stand in the way of our acceptance of the Mendelian hypothesis seem to us wholly illusory. He does not see why segregation should not occur in F_1, and asks the following questions, which seem to us quite easy to answer. "1. Why, if this explanation be true, do we get all the plants of the F_1 tall-dwarf crossing, tall, and not talls and dwarfs in the 1:2:1 ratio?" [*Answer:* Because the only one kind of union between gametes can take place, namely tall×dwarf.] "2. The recessive quality reappears in F_2. Is it not, then, equal to the dominant?" [*Answer:* Yes, if you like.]

"Clearly it is only temporarily recessive." [Precisely.]

"3. How is the recessive element expressed in F_1? It has not disappeared, as it reappears in F_2 unaltered. It is not expressed in the 'soma' of the plant: Where is it?" [*Answer:* In its germ cells.]

Dr. Hart's amended Mendelian scheme on p. 43 may be all right, but we cannot understand it, and we know of no experimental evidence for the assertion that there are three kinds of zygotes in F_1, a tall-tall, $\left\{\begin{matrix}\text{tall}\\\text{dwarf}\end{matrix}\right\}$tall, and a dwarf-tall. The reader must examine Dr. Hart's argument for himself.

The account of biometry is not very illuminating.

"Galton," we are told, "formulated certain laws, which are important—that of filial regression, for instance; but the most widely known one, Galton's law, setting forth the supposed fractions making up the full heredity in the individual, is of great importance, and has been specially fought over since Mendelism began to exert its sway over Evolution. . . . We may therefore, using Mendel's term of unit-character, say that, according to Galton, offspring inherit one-half of their unit-characters from their parents, and the most of the other half from the grandparents and great-grandparents."

And, again:—

"The amount of hard work bv biometricians in accumulating measurement-facts and noting minute variations is enormous. We get a good illustration of that in some of the late Francis Welldon's [*sic*] work. This eminent biologist was a most eminent follower [!] of biometric work, and . . . we see how Welldon spent himself, sometimes successfully and sometimes unfortunately, it must be said unsuccessfully, in arduous observations, unremunerative as yet in scientific deduction."

We cannot agree with this definition of biometry in the glossary at the end of the book, "Biometry is concerned with accurate measurements of 'organs,' their relations, and the laws governing their occurrence." It grieves us not to be inclined to praise this book, for the author is so manifestly earnest. But earnestness is not a sufficient qualification for authorship, and we cannot persuade ourselves that the book meets a long-felt want.

PHANTASMS OF THE LIVING.

Théorie Physico-chimique de la Vie et Générations Spontanées. By Prof. Stéphane Leduc. Pp. 202. (Paris: A. Poinat, 1910.) Price 5 francs.

PROF. LEDUC is not one of those who exaggerates the apartness of life. He thinks that the differences between an animate and an inanimate system are differences of degree, not of kind. It is in vain, he says, that one seeks for any exclusive characteristic of living things; it cannot be found in development, or nutrition, or irritability, or growth, or organisation, or reproduction. One discovers in living creatures only those physical forces which operate in the not-living world; biology, indeed, is part of the physico-chemistry of fluids. These conclusions are based partly on general reasoning, which appears to us fallacious, and partly on an interesting series of experiments, of which some illustrations may be given. A solution of 5 to 6 per cent. pure gelatine is spread on a slide; on this at regular intervals of 5 to 6 mm. one places by means of a pipette drops of ferrocyanide of potassium; these diffuse and meet and dry, giving a result like a tissue. The "artificial cells" pass through three stages of organisation, equilibration, and decline—ending, of course, in "death."

With a little ink and water one can conjure up all sorts of phantasms, some of them yielding very striking suggestions of karyokinesis. Periodic precipitations due to waves of diffusion may result in the artificial production of mother-of-pearl, which we can well believe, but we are not impressed by the "curious analogy" between some of the forms and "articulate animals." One of the figures is a little like a squashed scorpion, but is this sort of thing useful?

Prof. Leduc contributes an interesting short history of the biological study of osmotic phenomena, referring to Nollet, Rose, Traube, Harting, Quincke, and many others, and he gives a number of remarkable figures —the precise nature of which is in most cases left unstated—showing his own osmotic creations, produced by placing a fragment of calcium chloride in a saturated solution of carbonate of potash or tribasic phosphate of potash, or in similar ways. A fruitful solution to work with consists of 60 gr. of silicate of potash at 33°, 60 gr. of saturated solution of carbonate of soda, 30 gr. of saturated solution of di-basic phosphate of soda, and distilled water to make up a litre. Into this are placed fragments of chloride of calcium, and remarkable osmotic growths result. Some of the pictures of these and similar growths are mushroom-like, others worm-like, others coral-like, others shell-like, others mould-like, others leaf-like, and when a number are grouped together on a plate the effect is very quaint.

There can be little doubt that a study of these growths may in the course of time throw some light on the *rôle* of osmosis in organic growth. We think, however, that the author is going far beyond his results when he says that these osmotic growths exhibit "nutrition, assimilation, elimination, and irritability." The need of proof-reading is so conspicuous in this volume that we must direct attention to it. We read of Ernest Hœckel, Ulenhuth, Buttler Burke de Crambridge, Bütschli, and so on; there are three or four errors in the title of a book by Rhumbler; and we see a German word with an accent. These are minute details, but they are congruent with the impetuous superficiality of the main thesis of the book.

IRRIGATION WORKS.

Notes on Irrigation Works. A Course of Lectures delivered at Oxford under the auspices of the Common University Fund. By N. F. Mackenzie. Pp. ix+111. (London: Constable and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THESE lectures in book form have as their author an engineer whose competency to deal with his subject is sufficiently established by the fact that he was selected to be Under Secretary

for Irrigation to the Government of India. The duties of that office, coming after a career of practical work on irrigation schemes, would give that breadth of view with which a lecturer on so wide a subject as "Irrigation Works" should be endowed.

The irrigation works described in this book include more than the material works of irrigation, such as channels for irrigation and drainage and works of regulation. "Notes on Irrigation *Work*" would seem to be a more appropriate title. For, besides discussing weirs and irrigation channels—irrigation works properly so-called—the author describes what may be termed the embryonic growth of an irrigation project—that is, the preliminary surveys, studies, and calculations, which mark stages of development in the incomplete project. The final chapter, moreover, explains the revenue duties of the canal engineer of India. The canal engineer of Egypt is fortunate in escaping the harassing duties of revenue management, which in India are part of an irrigation officer's duties.

A separate chapter deals with the development of irrigation in Egypt since 1884 in a concise and comprehensive summary, and concludes with a short reference to possible future schemes. With this exception and a few references to works in Egypt under the head of weirs, the author has wisely drawn his illustrations from works in India with which he is personally acquainted, and treats his subject generally from the point of view of India. He thus avoids a fruitful source of error. The "eminent authority" whom he quotes as misconceiving the cause of the failure of Narora weir, leant too heavily on the broken reed of an official report, and fell into error for want of first-hand knowledge of the subject which he was using as an illustration. Mr. Mackenzie, with more caution, gives his opinion "with all reserve" as to the cause and manner of the accident. He may be right, but, as he points out, the local engineers decline to commit themselves to a positive opinion. There is, at least, one more theory of the cause of the accident, which has not yet appeared in print. Whatever the real cause may have been, the discussion, which has followed on the accident to the Narora weir and to which the author makes his contribution in his book, has been fruitful in establishing sounder principles upon which to base the design of weirs than had been recognised before.

A chapter on the design of irrigating channels is chiefly concerned with the important matter of silt deposit in the small distributing channels in the delivery zone of an irrigation system; but the method of water distribution on the rotation system is also described in general outline. An introductory chapter refers to the performance in the distant past and the promise in the near future of irrigation in Mesopotamia; also to the conditions which create a need of irrigation and drainage, and to the good effects of moderation and to the evil effects of excess in either.

The book is written in good, plain English, and is free from unnecessary technicalities, as lectures addressed to students should be, and as, indeed, all lectures might well be. The substance of the book is sound instruction, and irrigation engineers, as well as students, will find much useful knowledge in it, clearly expressed and convincingly demonstrated. A careful perusal of it would be a valuable preparation for a more detailed study of irrigation works and administration, either by books or by actual practice.

THE CRYSTALLINE SCHISTS.

Die Kristallinen Schiefer. Eine Darstellung der Erscheinungen der Gesteinsmetamorphose und ihrer Produkte. By Prof. U. Grubenmann. Zweite Auflage. Pp. xii+298+xii plates. (Berlin: Gebrüder Borntraeger, 1910.) Price 20 marks.

ORIGINATING in a course of lectures at Zürich, based largely on the author's own researches among the crystalline schists of the Alps, Prof. Grubenmann's book has already made for itself a place in petrographical literature. The two parts, general and special, issued separately in 1904 and 1906 respectively, are in the new edition included more conveniently in a single volume; but the general plan of the work remains unchanged, and the additions found here result merely from the growth of material during the last five years. Thus, in the first part, there is some revision of those sections which deal with the application of physico-chemical principles, and some interesting illustrations of original sedimentation, mixed injection, &c., are drawn from recent work in Finland and Scandinavia. The additions made to the second part of the book are perhaps more important, including a large number of chemical analyses, and some simplification of the classificatory scheme.

The general principles of Prof. Grubenmann's treatment are already known to petrologists. His classification is based primarily upon chemical composition. No distinction is made between metamorphosed sediments and metamorphosed igneous rocks, for it is urged that, even if their original characters are not wholly obliterated, metamorphism has set so marked a stamp upon them that the new characters supersede the old in significance. The author adopts Osann's chemical classification, originally devised for igneous rocks alone, and in this way arrives at twelve groups of crystalline schists. In each group there is made further a threefold division corresponding with different zones of depth, where the conditions as regards temperature and pressure are presumed to differ in an important degree. This division, an amplification of Van Hise's conception, is described as a "physical-geological" one; but, since the actual depths of the several zones are not the same in different groups of rocks, the geological significance is merely of a limited scope.

The distinction made between crystalline schists and "contact-rocks," which latter are excluded from consideration, seems to us an artificial one, and is difficult to defend in a scheme professedly based on the actual characters of the rocks. Barrow has shown that the great metamorphic aureoles of the Scottish Highlands can be divided into three zones, having sillimanite, cyanite, and staurolite as their

characteristic minerals. Here it is clear that the formation of one or other of these silicates depended solely on temperature, and in no wise on depth; but in the book before us sillimanite figures as a distinctive mineral of the deepest zone, and cyanite and staurolite of the middle zone. We are led to suspect that the author has overrated the influence of pressure as a factor in metamorphism. Such experimental data as we possess go to show that even very high pressures may not displace greatly the temperature-limits of stability of the rock-forming silicates.

Apart from such considerations, more or less theoretical, the work is a mine of valuable information. The classification at least serves its purpose as a standard of comparison, and the systematic treatment of the structures of crystalline schists will be especially useful. A. H.

PLANT LIFE OF MARYLAND.

Maryland Weather Service. By F. Shreve, M. A. Chrysler, F. H. Blodgett, and F. W. Besley. Vol. iii., The Plant Life of Maryland. Pp. 533. (Baltimore, U.S.A.: Johns Hopkins Press, 1910.)

THE weather service of the American State of Maryland, maintained by the Johns Hopkins University, Maryland Agricultural College, and the United States Weather Bureau, receives a broad interpretation. The first volume of the series dealt with the physiography and meteorology of the State, the second presented the results of many years' study of the climate and weather of Baltimore and vicinity, while the third is connected with the former in so far as vegetation is dependent upon physiography and climatic conditions. The main purpose of the present volume is to present an ecological description of the vegetation, which is demarcated into three zones. The coastal zone spreads inland as far as the "fall-line"; thence to a contour line of 1500 feet extends what is designated as the "midland" zone, and a mountain zone comprises land above that altitude. The term, "fall-line," it may be noted, is nowhere explained; reference to another source shows that at the junction of the Cretaceous or Cenozoic with older formations the rivers have falls or rapids.

The division into these three zones is suggested by the occurrence in the central counties of many species having a wide range, coupled with the appearance of a conspicuous southern floral element in the coastal zone, and an appreciable admixture of northern elements in the mountain zone; these facts throw some light upon the historical sequence of events. As for the details, these are well elaborated, and due consideration is given to the limits imposed by soil constitution, both physical and chemical, and by topography. Climatic conditions are extremely favourable to tree growth, so that forests are important in each of the zones. Originally extensive forests of white pine and pitch pine existed in the western part of the State, but now the white pine is limited to isolated specimens. The converse process is seen in southern Maryland, where scrub pine spreads over land cultivated before the Civil War; this is a first stage that is altered by the incursion of oak, and later by hickory. Apart from the forests, the various marsh regions in the coastal zone are interesting, also the serpentine barrens and Susquehanna gravels in the midland zone. To make the survey more complete, sections are devoted to agricultural and forestry matters, and an account of the floristic geography with a list of plants is supplied by Dr. F. Shreve. The text is illustrated by a considerable number of excellent photographs and by a few maps that would be more useful if the scale were larger. The volume is highly creditable to Dr. Shreve and his associates, and will take rank with the best local ecological studies.

OUR BOOK SHELF.

Salvarsan or 606 (Dioxy-Diamino-Arsenobenzol): its Chemistry, Pharmacy, and Therapeutics. By Dr. W. H. Martindale and W. W. Westcott. Pp. xv+77. (London: H. K. Lewis, 1911.) Price 5s. net.

IN this little book, the authors summarise all the essential information contained in the numerous publications that have appeared up to date on the Ehrlich-Hata remedy for syphilis. "Salvarsan" is the trade name given to the compound—which is chemically dioxy-diamino-arsenobenzol—synthesised by Ehrlich and his collaborators, and first introduced under the designation "606." Ehrlich has for some time past been studying the effects of various anilin dyes and organic compounds of arsenic on trypanosomes and other protozoan parasites. In quick succession he brought out more or less effective remedies, such as trypan red for bovine piroplasmosis (Texas fever), atoxyl and arsenophenylglycine for trypanosomiasis of man and animals, and, finally, "606" for spirilloses, diseases caused by spirillar micro-organisms, such as relapsing fever and syphilis.

S. Hata, of Tokio, conducted researches with "606" on the spirochætes of relapsing fever in rats and mice, and subsequently on the spirillosis of fowls. The drug was found to be extraordinarily efficacious, and it was an obvious further step to try it on syphilis, another spirochæte disease, with correspondingly successful results. Mercury has been used for centuries as a remedy, the one remedy, for syphilis, but a proper course of treatment with it extends over months, and it is impossible to make many patients realise the necessity for this, and hence the disease relapses, with, in many instances, dire results. With salvarsan, however, it is claimed that a single dose will in many instances effect a cure, an enormous advantage.

There can be little doubt that in salvarsan we have a most potent remedy for the cure of syphilis, though whether it will do all that has been claimed for it time alone can show. Unfortunately the drug is toxic, and requires to be administered in a special manner; it is not altogether free from danger in particular cases, and is contra-indicated in some of the worst forms of syphilis, *e.g.*, when the nervous system is involved. In the book under review, the authors give complete directions for the preparation and administration of the drug, and epitomise the precautions to be taken and the contra-indications for its use, and it should prove a very useful guide for the practitioner. Summaries of some of the principal contributions on the remedy are included, and a full bibliography is appended. R. T. H.

Outlines of Zoology. By Prof. J. Arthur Thomson. Fifth edition, revised. Pp. xxii+855. (Edinburgh, Glasgow, and London: H. Frowde and Hodder and Stoughton, 1910.) Price 12*s.* 6*d.* net.

IN the case of a book written by such an experienced writer and teacher as Prof. Thomson, and especially at the appearance of a fifth edition, there is little room for critical comment. The qualities that have made this work such a successful handbook are well known to generations of Scotch students; the conciseness of its information, the caution of its statements, and the clearness of its comparisons. Even in its older form this text-book was notable for its close texture, for the compact nature of its information. Now that all the bearings of modern work upon its topics have been incorporated, it is a rendering not only of the outlines of zoology, but of much of the "corpus" of zoological knowledge, and he would indeed be a full man who could really possess the store of information, both old and new, that is contained in its pages.

Almost the only general criticism we have to make is the inadequacy of the treatment of the cœlom-theory. This important and difficult subject has recently been expounded so clearly in Prof. Sedgwick's text-book of zoology, and is of such fundamental importance that the fragmentary presentation in the book before us is a matter of regret, affecting, as it naturally does, nearly every division of the animal kingdom. The discussion on Echinoderm larvæ on p. 278 fails through such a want of what Moseley, we believe, described as "morphological grip." The "absence of the apical sense-organ" mentioned at the bottom of that page is surely an oversight. The apical plate is well developed in Echinid larvæ, and even bears eye-spots.

The text has been most carefully revised. Very few mistakes have been overlooked, but two call for mention. One of the most recently discovered insects —Acerentomon—is figured, a welcome sight, on p. 362, and is described there as being without antennæ, though antennæ are figured and described in the legend. The other occurs on p. 235, where, in the second paragraph, the word "sexes" is written "series." Such minute defects are, however, of little account. A notable feature of this edition is the large number of new figures.

Étude sur l'Assurance complémentaire de l'Assurance sur la vie. Avec de nombreux développements sur les Assurances contre la Maladie et l'Invalidité. By P. J. Richard. Pp. iv+118. (Paris: A. Hermann et Fils, 1911.) Price 3.50 francs.

THERE has lately been a movement among insurance companies in various parts of the world to combine with ordinary life insurance benefits dependent upon sickness, so that in the event of incapacity no premiums are payable, and sometimes an annuity is received. This movement has led to the mathematical investigation of the underlying principles, and the subject has proved attractive to one or two writers, owing, perhaps, to its complexity, for it is necessary to deal with the probabilities of death, sickness (permanent and temporary), and recovery, all of which vary with the age and occupation of the life assured, as well as with the time that has elapsed since the person was medically examined for insurance. M. Richard, in his recent publication, evolves the formulæ that might be used, and gives specimen tables to enable us to form an idea of how the premiums might be calculated, although, as he points out, we have not sufficient statistical data to enable us to use his formulæ satisfactorily.

The best solution of the problem is probably the statistical one which sets out on one hand the payments made to the offices, and on the other the various benefits allowed to the insured. The subject is, however, at present too new on its practical side to enable us to use this solution, and until experience provides us with data, M. Richard's neatly-printed little book will prove interesting to those who are concerned with actuarial problems in theory and practice, and have perhaps already been attracted to the subject on which he writes by the earlier work of Schaertlin and a few other writers.

Recueil d'Œuvres de Léo Errera. Physiologie générale. Philosophie. Pp. xiv+400. (Brussels: H. Lamertin; London: Williams and Norgate, 1910.)

THE late Prof. Errera was possessed of an inherent faculty for analysing subtle problems by a process of concise, logical argument, and this faculty is particularly apparent in his treatment of certain of the general physiological subjects discussed in this fourth volume of collected papers. One of the best instances is supplied by the notes arranged for a course of lectures debating the existence of a vital force in plants. Two lectures on sleep were delivered before an audience composed largely of doctors. The view put forward by the author that sleep is induced by the formation of toxic bodies was opposed by several doctors present, but was not refuted.

Three papers only can be classed as direct contributions to botany, although arguments are deduced from the plant world in all of them. One of these discusses the question whether acquired characters can be inherited, and answers it in the affirmative on the strength of cultural experiments with *Aspergillus niger*, carried out by Dr. Hunger in the Botanical Institute at Brussels. Another paper dealing with the struggle for pre-eminence as exemplified by the growth of lateral branches of a conifer when the main stem is destroyed, was read before the British Association at the Cambridge meeting in 1904. Two essays on the individual and the assertion of life are published for the first time. The papers generally manifest a copious knowledge and ready application of the latest scientific facts, and botanists in particular will appreciate the arguments and views expressed with regard to spontaneous generation and the existence of a soul in plants.

Wild Flowers as They Grow. Photographed in Colour direct from Nature. By H. Essenhigh Corke, with descriptive text by G. Clarke Nuttall. Pp. vii+197. (London: Cassell and Co., Ltd., 1911.) Price 5*s.* net.

THE first point of interest in this volume is supplied by the coloured illustrations, which are the outcome of photographs taken from nature direct by the Lumière process, and reproduced by a four-colour printing operation. Most of the colour tones are well rendered, notably the yellow and green of the primrose, the blues of the harebell flower, and the blended colours of the bee orchis; only the yellow colours of the dandelion and toadflax are distinctly incorrect. From a combined natural and artistic point of view the wild strawberry is excellent, as are several others, especially when it is considered that an exposure of minutes is required for taking the photographs. In the accompanying letterpress Mr. Nuttall presents a clear and precise description, adapted for general readers, of the chief features of biological interest observable in the twenty-five plants selected, and comments on the popular names, superstitions, and other such details. The text and illustrations together form an attractive volume, and the cost is moderate.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Discovery of the Teeth of Palæolithic Man in Jersey.

AT the close of last year Messrs. E. T. Nicolle and J. Sinel reported (*Man*, December, 1910, p. 185) some of the results of an exploration of a Palæolithic cave-dwelling situated in the cliffs of St. Brelade's Bay, on the south coast of Jersey. Amongst the mammalian bones found on the floor of the cave, Dr. A. Smith Woodward and Dr. C. Andrews recognised remains of the woolly rhinoceros, the reindeer, and two varieties of horse. Abundant evidence of former hearths and numerous flint implements were found with the bones. Nine human teeth were also found, and it is to the nature of these I wish now to direct attention. The exploration of the cave was continued by Mr. R. R. Marett, reader in social anthropology, Oxford University, who is now preparing for publication a full account of the various "finds" made in the Jersey caves. By his courtesy I was given an opportunity of examining the human teeth, which are to be fully described by Mr. Francis H. J. Knowles. Three of the teeth, all of which are fossilised, but in an excellent state of preservation, belong to the upper jaw—a second left premolar, a first right and a second left molar; the six teeth from the lower jaw are a canine, first and second premolar and second molar of the left side, a second incisor and second molar of the right side. It is thus possible to reconstruct the dentition of this individual —for clearly all are from the same set—with a fair degree of accuracy. The recognition of each member of the series was made easy by their close resemblance to the teeth of the Heidelberg mandible, usually regarded as the oldest example of Pleistocene man yet discovered in Europe. The teeth of the Gibraltar cranium, which is probably a very primitive and early example of the Neanderthal type, were also of assistance. In many features the teeth of the Krapina men are recalled. There can be no doubt that the St. Brelade individual to whom these teeth belonged must be ranked as one of the most, if not the most, primitive of the examples of the Neanderthal type yet discovered.

When the Heidelberg mandible was found in 1907 embedded in the Mauer sand beds, at a depth of nearly 90 feet, anthropologists were surprised by the fact that while the crowns of the teeth did not greatly exceed modern dimensions, the mandible itself was so massive as to recall the form found in the orang and gorilla. The important fact brought home to us by the Heidelberg discovery was that the outstanding feature of the teeth of Pleistocene man, as compared with those of modern man, are the size and character of the roots of the teeth, not the size or character of their crowns. The stout roots and massive mandible indicated the roughness and toughness of the food, and the huge muscular strength exerted in mastication. Now, as regards the characters of the roots, these now found in the cave of St. Brelade exceed all human teeth previously discovered. Although the crowns of the teeth are smaller than those of the Heidelberg mandible, the roots are in most cases absolutely, and in other cases relatively, greater in their diameters, and indicating a smaller but still more powerful mandible in the St. Brelade individual.

The characters of the roots of the St. Brelade teeth may be seen from the adjoining figure. Two of the teeth are represented, A, the left lower canine from its proximal or mesial aspect, and B, the second lower molar, also from the same point of view. Typical specimens of the same teeth in a modern European are shown in A′ and B′. The difference in thickness is striking; the length of the roots is nearly the same. So specialised are the tooth roots in Neanderthal man that Klaatsch and Adloff exclude this race from the ancestry of modern man. In the specimens figured of the second lower molars, both St. Brelade and modern, the two roots are fused, but the process of fusion is absolutely different in the two. In the Brelade specimen the roots have become so hypertrophied and strengthened that they have come together as a result of overgrowth; in the modern molar the roots have dwindled and atrophied and become approximated by a process of retrogression. In the anthropoids, as in well-developed molars of modern man, the roots are well developed, separate, and spread. The roots of the first molars of modern man thus resemble those of the anthropoid, whereas the typical molars of the Neanderthal race appear to differ absolutely from the anthropoid type. At first sight it appears as if Klaatsch and Adloff must be right in tracing the root-forms in the molar teeth of modern man to a primate ancestor, and in excluding the highly specialised roots of Neanderthal man from the ancestry of the molars of modern man. In this I think they are wrong, for were retrogression to overtake the masticatory development of the Neanderthal type of man, then the apparent fusion of the roots would vanish, and they would again appear as separate structures as in the well-developed molars of modern man. This stage of retrogression can be seen in the teeth of the men of Spy. When we speak of the Neanderthal race we must remember that it probably endured throughout the Pleistocene period, one covering several hundred thousand years, and that we must expect to find many forms. The Spy men appear to belong to the latter part of the period; the Heidelberg and Brelade men to the earlier.

The teeth of Pleistocene man are highly specialised as regards their roots, a character in which they altogether depart from the anthropoid form. The change in root form

is best explained by the supposition that the human method of mastication had been evolved from the anthropoid long before the end of the Pliocene period. The peculiarity of the human method of mastication is the side to side or grinding movement of the lower jaw; in the anthropoid the movement is a crushing or cutting movement. The great canine teeth are implanted as maxillary guides to prevent any side to side action and ensure that the mandible will not slip or "skid" when the powerful muscles of mastication are at work. The human method of mastication was only possible when the canine teeth began to sink, as in the female chimpanzee, almost to the level of the other teeth. That the human canines were once anthropoid in form there can be no doubt; their embryological history leaves room for no other opinion on this point. When, however, the side to side movement in mastication was evolved, the implantation of the teeth had to be strengthened to meet the side to side strain. It is that stage which is preserved for us in Pleistocene man. It is very remarkable that in modern times the side to side movement has disappeared in highly civilised races, and the former cutting bite, ensured by the lower incisors passing up behind the upper, has appeared. With the improvement in food in more modern times, the usual primate form of tooth roots reappeared. In the St. Brelade dentition the first lower premolar is highly specialised, as is the case in the anthropoid; its specialisation originally depended on the fact that it had to serve as the opponent of the massive upper canine. The discovery, made under the auspices of the Société Jerviaise, thus not only serves to show the extension of the Neanderthal type to the Channel Islands, but supplies most important facts bearing on the evolution of man.

A. KEITH.

Botanical Research at Peradeniya.

IN *The Times of Ceylon*, April 12, is published a communication, dated June 20, 1910, from the Governor of Ceylon to the Secretary of State for the Colonies on the question of a Department of Agriculture for that colony. With the proposals put forward in that memorandum we are not concerned, but there is one feature in connection with it against which we cannot but strongly protest. Appended to the memorandum are certain notes by Mr. Dunstan, of the Imperial Institute, of which one runs as follows:—

"Owing to the agricultural duties which are now performed by the botanical officers at Peradeniya, and for which they are not specially qualified, no botanical research is being carried on, and the scientific reputation of the establishment, which was at a high level in the days of Thwaites and Trimen, is suffering."

We are confident that this statement cannot be justified. A reference to the Annals of the Royal Botanic Gardens, Peradeniya, founded by Dr. Willis in 1901, gives evidence of the amount of valuable work that has been carried out in recent years. We may mention, without attempting to be exhaustive, the researches of Messrs. Green, Holtermann, Keeble, Lang, Lock, Parkin, Pearson, Petch, Smith, Svedelius, Willis and Wright, which have all been carried out at Peradeniya during Dr. Willis's directorship. At the present time Dr. Willis and Dr. Lock, and Messrs. Petch and Green, are actively engaged in research.

In our opinion there would be a general agreement among biologists that the high reputation of the Royal Botanic Gardens has been fully maintained—to say the least of it—under the direction of Dr. Willis. To the sympathy of the staff with scientific progress, and to their ability in smoothing the way for those who visit the gardens for purposes of research, two of us, who lately stayed there for scientific work, can personally testify.

We are relieved to read that the Secretary of State, in his answer to the memorandum, has not associated himself with the paragraph above quoted. But we feel bound to make some protest against what seems to us to give an entirely misleading impression of the high position, as a centre of research, which Peradeniya has attained, under Dr. Willis's initiative and guidance.

R. H. BIFFEN, Professor of Agricultural Botany.
F. F. BLACKMAN, Reader in Botany.
FRANCIS DARWIN.
J. STANLEY GARDINER, Professor of Zoology.
R. C. PUNNETT, Professor of Biology.
A. C. SEWARD, Professor of Botany.
A. E. SHIPLEY, Master of Christ's College and Reader in Zoology.
T. B. WOOD, Drapers Professor of Agriculture.
Cambridge University, May.

The Heraldic Yale.

SUPPOSING a traveller on his return from Africa were to tell a friend in the Heralds' Office that he had seen a beast, in general appearance like an antelope, with divided hoofs and a long tail bunched out at the end like an elephant's: having horns, roughly corrugated and protuberant on his forehead like a ram's, though he could not be quite sure as to their form, because he saw him only in profile, and they seemed movable, one sometimes pointing forward and the other backward: further, that he had two enormous tusks and a lower jaw like a goat's, that is, with a long beard.

His friend might take out his pencil and embody what he was told in a rough sketch something like this, Fig. 1, saying, "That's very interesting, for your description of the beast combines all the characters of the heraldic Yale, which some say had an African origin."

Supposing the traveller then strolled round to the British Museum and reproduced, as well as he could, the sketch drawn by his heraldic friend, but, on being cross-examined, was forced to admit that what appeared to him to be tusks might have been the tips of the beast's curved horns, which from another point of view did seem to point different ways: that the upper part of his tail was not covered with short hair only, as in the elephant, but was more bunchy below, and from the animal's manner of whisking it about the bunchiness was exaggerated. Supposing, also, that he was not clear as to the points or protuberances on the top of the animal's head—whether they

FIG. 1.

were the tips of his ears or bases of horns, or both—and that he was led to modify his picture, as in Fig. 2.

His British Museum friend also might say, "That's very interesting, for it is not unlike an African beast known as the gnu, from its native name nju."

Talking the matter over afterwards with a third friend, who was learned in folk-lore, he was told that it was

FIG. 2.

very interesting as an example of how heralds and artists had modified in time the strange form of the gnu into accord with the characters of the only animal of the kind which they did know, namely, the antelope.

T. MCKENNY HUGHES.

Dynamical Enunciations.

UPON Newton's classic definitions and laws of motion various criticisms have been passed by A. E. H. Love, E. Mach, K. Pearson, H. Poincaré, and others.

Some writers emphasise one aspect of the subject, some another, and most are destructive rather than constructive. But, if the full value of this critical work is to reach the ordinary student, it seems desirable that teachers should have at hand some brief statements embodying those central positions on which there is fair agreement in modern thought.

As an attempt in this direction, the following enunciations are, with great diffidence, submitted:—

Law of Motion.—Accelerations occur only in opposite pairs, the ratios of which are constant for given particles.

Definition of Mass.—The masses of particles are positive constants, inversely as their mutual accelerations.

Definition of Force.—Force is the product, mass into acceleration, and has the direction of the acceleration.

Choice of Axes.—Since motion is relative, force and mechanics are relative also. Hence, the foregoing and any problems based upon them should be referred to axes which, in each case, yield a mechanics most appropriate to the phenomena under discussion.

Nottingham, May 12. E. H. BARTON.

I AM much obliged to the Editor of NATURE for giving me an opportunity of commenting upon Prof. Barton's letter. In the second edition of my book on "Theoretical Mechanics" I have expressed my ideas on the subject at such length that it is unnecessary to go into details here. It may suffice to say that the first two of Prof. Barton's proposed enunciations seem to me to be too abbreviated to be of much value. To anyone who understands the theory of mechanics, as explained by the writers whom he cites, such statements could be of little use, while to anyone who does not they might be misleading. The third enunciation does not distinguish between force and the quantity which Routh called "effective force" and I call "kinetic reaction." The distinction appears to me to be important. The fourth enunciation would seem to permit an undesirable degree of freedom in respect to the choice of a reference system. I do not wish to suggest that Prof. Barton means by his brief enunciations something different from what I mean in my book, but rather to point out that such brevity as he aims at may be inconsistent with clearness in the statement of principles. One way of bringing the results of modern critical discussions concerning the laws of motion within the reach of the "ordinary student" would be to publish a short tract, on the same scale, say, as Maxwell's "Matter and Motion." In such a tract summary enunciations could be accompanied by adequate explanations. Would not this be better than providing teachers with a set of enunciations?

May 18. A. E. H. LOVE.

Further Experiments with the Gramophone.

I HAVE just seen Prof. McKendrick's letter in your issue of April 20, describing the experiments he has made with a view to improving the quality of the notes reproduced by a gramophone.

Some five or six years ago, when I was working at the auxetophone, I tried a number of similar devices, and, to a very large extent, succeeded in getting rid of the objectionable hissing and scratching sounds.

One of the horns I tried consisted of a wooden tube of rectangular section and gradually increasing area, which was doubled backwards and forwards on itself in the shape of a flat zigzag, and was practically identical with the metal horn illustrated in your paper.

In the end I found it was best to use a coiled metal trumpet of large size and gradually increasing area and about 48 feet long, in which I introduced several right-angled and "U" shaped bends; further, I fitted a "T" shaped tube close to the reproducer, which made a considerable improvement in the quality of the tone. The longer sound waves passed through this "T" shaped bend with little loss, but the very short waves, which caused most of the scratching, were absorbed at the bend, especially if the blank end of the "T" was filled with cotton wool or some other similar substance, or if an inner sliding tube, with the end closed, was introduced into the blank end of the "T," and pushed in, so as to throttle the sounds at the bend.

I also fitted a flexible joint between the needle and the actual reproducer, which further eliminated these high-period vibrations. This flexibility was obtained by giving the joint very large clearance, and filling the space in between with a highly viscous substance.

I found considerable improvement, as well, in the tone when a paper diaphragm, or when moderate quantities of paper, linen, &c., were put in the trumpet.

In conclusion, I might say that my own experiments quite bear our Prof. McKendrick's opinion on the importance of using suitably shaped trumpets in order to obtain pleasant natural reproductions of musical tones and of the human voice. CHARLES A. PARSONS.

Heaton Works, Newcastle-on-Tyne, May 17.

German East African Dinosaurs.

WITH reference to your note on the German East African Dinosaurs (NATURE, May 18, p. 390), *Die Woche* of May 6 reproduces an interesting series of photographs of the remains, taken on the site of the excavations.

Matlock, May 20. F. GILLMAN.

BREATH FIGURES.

THE manner in which aqueous vapour condenses upon ordinarily clean surfaces of glass or metal is familiar to all. Examination with a magnifier shows that the condensed water is in the form of small lenses, often in pretty close juxtaposition. The number and thickness of these lenses depends upon the cleanness of the glass and the amount of water deposited. In the days of wet collodion every photographer judged of the success of the cleaning process by the uniformity of the dew deposited from the breath.

Information as to the character of the deposit is obtained by looking through it at a candle or small gas flame. The diameter of the halo measures the angle at which the drops meet the glass, an angle which diminishes as the dew evaporates. That the flame is seen at all in good definition is a proof that some of the glass is uncovered. Even when both sides of a plate are dewed the flame is still seen distinctly though with much diminished intensity.

The process of formation may be followed to some extent under the microscope, the breath being led through a tube. The first deposit occurs very suddenly. As the condensation progresses, the drops grow, and many of the smaller ones coalesce. During evaporation there are two sorts of behaviour. Sometimes the boundaries of the drops contract, leaving the glass bare. In other cases the boundary of a drop remains fixed, while the thickness of the lens diminishes until all that remains is a thin lamina. Several successive formations of dew will often take place in what seems to be precisely the same pattern, showing that the local conditions which determine the situation of the drops have a certain degree of permanence.

An interesting and easy experiment has been described by Aitken (Proc. Ed. Soc., p. 94, 1893). Clean a glass plate in the usual way until the breath deposits equally.

"If we now pass over this clean surface the point of a blow-pipe flame, using a very small jet, and passing it over the glass with sufficient quickness to prevent the sudden heating breaking it; and if we now breathe on the glass after it is cold, we shall find the track of the flame clearly marked. While most of the surface looks white by the light reflected from the deposited moisture, the track of the flame is quite black: not a ray of light is scattered by it. It looks as if there were no moisture condensed on that part of the plate, as it seems unchanged; but if it be closely examined by a lens, it will be seen to be quite wet. But the water is so evenly distributed, that it forms a thin film, in which, with proper lighting and the aid of a lens, a display of interference colours may be seen as the film dries and thins away."

"Another way of studying the change produced on the surface of the glass by the action of the flame is to take the [plate], as above described, after a line has been drawn over it with the blow-pipe jet, and when cold let a drop

of water fall on any part of it where it showed white when breathed on. Now tilt the plate to make the drop flow, and note the resistance to its flow, and how it draws itself up in the rear, leaving the plate dry. When, however, the moving drop comes to the part acted on by the flame, all resistance to flow ceases, and the drop rapidly spreads itself over the whole track, and shows a decided disinclination to leave it."

The impression thus produced lasts for some days or weeks, with diminishing distinctness. A permanent record may be obtained by the deposit of a very thin coat of silver by the usual chemical method. The silver attaches itself by preference to the track of the flame, and especially to the *edges* of the track, where presumably the combustion is most intense. It may be protected with celluloid, or other, varnish.

The view, expressed by Mr. Aitken, which would attribute the effect to very fine dust deposited on the glass from the flame, does not commend itself to me. And yet mere heat is not very effective. I was unable to obtain a good result by strongly heating the *back* of a thin glass in a Bunsen flame. For this purpose a long flame on Ramsay's plan is suitable, especially if it be long enough to include the entire width of the plate.

It seems to me that we must appeal to varying degrees of cleanliness for the explanation, cleanliness meaning mainly freedom from grease. And one of the first things is to disabuse our minds of the idea that anything wiped with an ordinary cloth can possibly be clean. This subject was ably treated many years ago by Quincke (Wied. Ann. II., p. 145, 1877), who, however, seems to have remained in doubt whether a film of air might not give rise to the same effects as a film of grease. Quincke investigated the maximum edge-angle possible when a drop of liquid stands upon the surface of a solid. In general, the cleaner the surface, the smaller the maximum edge-angle. With alcohol and petroleum there was no difficulty in reducing the maximum angle to zero. With water on glass the angle could be made small, but increased as time elapsed after cleaning.

As a detergent Quincke employed hot sulphuric acid. A few drops may be poured upon a thin glass plate, which is then strongly heated over a Bunsen burner. When somewhat cooled, the plate may be washed under the tap, rinsed with distilled water, and dried over the Bunsen without any kind of wiping. The parts wetted by the acid then behave much as the track of the blow-pipe flame in Aitken's experiment.

An even better treatment is with hydrofluoric acid, which actually renews the surface of the glass. A few drops of the commercial acid, diluted, say, ten times, may be employed, much as the sulphuric acid, only without heat. The parts so treated condense the breath in large laminæ, contrasting strongly with the ordinary deposit.

It must be admitted that some difficulties remain in attributing the behaviour of an ordinary plate to a superficial film of grease. One of these is the comparative permanence of breath figures, which often survive wiping with a cloth. The thought has sometimes occurred to me that the film of grease is not entirely superficial, but penetrates in some degree into the substance of the glass. In that case its removal and renewal would not be so easy. We know but little of the properties of matter in thin films, which may differ entirely from those of the same substance in mass. It may be recalled that a film of oil, one or two millionths of a millimetre thick, suffices to stop the movements of camphor on the surface of water, and that much smaller quantities may be rendered evident by optical and other methods. RAYLEIGH.

NORTH SEA FISHERY INVESTIGATIONS.[1]

THE third Report on the Fishery and Hydrographic Investigations conducted by the Marine Biological Association under the international organisation is the most interesting yet published. It contains statistical papers dealing with the abundance and migrations of edible fishes in the North Sea; the age and growth-rate of plaice from the same region; and the fishing action of trawl nets with respect to the size of mesh. There are also accounts of the distribution of fish-eggs in the North Sea during the summer, and of the physical conditions of the water of the English Channel, and its contained plankton throughout the year 1906.

The first, and most lengthy, paper in the Report is one of unusual interest and value. In it Miss R. M. Lee has summarised and discussed a series of records kept by the masters of nine Grimsby steam trawling vessels, which fish over the whole of the central part of the North Sea. These records cover the period 1904–8, and represent the results of 14,543 hauls of the otter trawl net, which means about 53,995 hours' fishing. The statistics have been treated most clearly and concisely, and show for each of twenty-three areas into which the whole North Sea has been divided, the monthly average quantities of each of the more important species of marketable fishes caught by the vessels per ten hours' trawling. In order to render these results comparable with those obtained by other statistical workers (Fulton, D'Arcy Thompson, Redeke), the author has calculated factors which enable one fishing unit to be converted into any of the others used.

From these data (which are based on the practical knowledge acquired by a number of very experienced fishermen) Miss Lee has deduced the general distribution of each of the species of fish considered over the whole area of North Sea represented, the migrations from one subarea to others, the spawning movements of the fishes, the variations in density from month to month, and the general change in the productivity of the fishing grounds from year to year. Her paper, and a former one which dealt in a similar way with records kept by a number of Lowestoft sailing-trawler skippers, form a picture of the present condition of the North Sea fishing area which must prove to be of inestimable value for the fishery administrators of the future. If, in the early 'seventies, before steam trawling had become the predominant method of fishing, such a summary by a trained statistician had been made, how much controversy and trouble might have been avoided! Even as it is, a comparison of Miss Lee's results with those imperfect records which we possess of fishery operations in the North Sea in the 'seventies and 'eighties shows most strikingly the change which has taken place, and enables us to realise, to a degree hitherto unattainable, how very great must have been the diminution of the stock of fish inhabiting the North Sea. It is not a question of the decadence of a fishing ground, but rather the fishing-out of an accumulated stock, and the establishment of a new equilibrium, on a lower level, between the natural powers of recuperation of a fish population and the catching power of the British and Continental fishing fleets. And there can be little doubt that, in the absence of concerted measures for cultivation, this equilibrium must settle down to still lower levels. It is sincerely to be hoped that this work may be continued by Miss Lee.

Dr. Wallace has continued his former work on the natural history of the plaice and subjects to detailed analysis, a mass of data representing individual deter-

[1] Third Report (Southern Area), on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1906–8. [Cd. 5546]. 1911.

minations of length, sex, age, and weight of over 20,000 plaice from various North Sea fishing grounds. The results show clearly that the conditions with regard to nutrition vary from ground to ground, and they suggest that a knowledge of these conditions may, in time, enable fishery authorities to increase the productivity of the North Sea by the "transplantation" of fish from grounds on which the growth is slow to other grounds on which the conditions of life are more favourable. Dr. Wallace's paper supplements that of Miss Lee in that it gives us data which cannot be obtained by ordinary methods of commercial statistics, and which are quite essential for the proper understanding of the latter.

Mr. Todd's experiments on "covered nets" are designed to elucidate the fishing action of the trawl net in respect of the numbers and sizes of fish which escape capture by the mesh employed. The outside parts of the trawl nets used have been covered by other loose nets of narrower mesh, and the fish which have escaped capture by the inner wide-meshed net are intercepted by the outer narrow-meshed net. Mr. Todd tabulates and discusses the results of a number of such experiments.

Mr. Wollaston gives an account of the first cruise made by an English vessel expressly for the purpose of determining, by means of specially constructed nets, the distribution of fish-eggs in the open sea. The cruise was made in June, 1909, in the North Sea, by the vessel *Huxley*, and tables are given which show in detail the results of the experiments made at each observation station, while synoptic charts represent the numbers and distribution of the eggs of certain species of summer-spawning fish present per square metre of sea surface in the neighbourhood of the stations. By far the most interesting part of Mr. Wollaston's paper is that devoted to a description of the methods employed. The net was specially constructed, and its "constants" were calculated so that it was possible to estimate approximately the average volume of water which was filtered through its meshes. Welcome improvements in the methods of preservation of the fish-eggs caught, so as to avoid distortion, and obscuration of finer details of structure have been developed. The author then proceeds to apply the methods of modern biometricians to the analysis of his data. It has hitherto been impossible, in work of this kind, to avoid the confusion of eggs belonging to closely allied species, since in some cases a fish-egg can only be identified by measuring its diameter, and that of the contained oil globule. In some pairs of species these pairs of characters overlap, and it was an error of this nature that vitiated (to some degree) the results of Hensen's famous North Sea cruise of 1895. Mr. Wollaston, however, elaborates a mathematical method whereby the eggs belonging to two such overlapping species can be separated. If in a number of examples of the eggs of one species two measurable variable characters, such as the diameters of the egg and oil globule, be determined, then the frequencies of these two variables can be represented by an equation, which is that of an elliptic "correlation surface." But a group of eggs may include two species allied together in that the diameters of the eggs and those of the oil globules do not differ greatly; nevertheless it is only by these characters that the eggs may be recognised. In such a case the correlation surfaces overlap. Mr. Wollaston then shows that it is always possible, by means of relatively simple mathematical methods, to decompose the compound correlation surface so obtained; and to estimate with a very fair degree of probability the actual numbers of each species of egg in the group. We believe that this method is quite a novel one.

The plankton and hydrographic investigations relate to the year 1906. Mr. Bygrave has given the usual tables recording the distribution and relative density of the planktonic organisms present in the Channel in that year. He shows that the density of oceanic plankton may be correlated with the salinity of the water. The seasonal changes taking place in the abundance of the plankton are also discussed, and the author adopts Brandt's hypothesis, according to which the spring maximum of density of Diatom and Peridinian plankton is the result of the accumulation of food-stuffs in the water during the preceding winter months, while the summer minimum is due to the activity of denitrifying bacteria, which decompose nitrogen compounds, so that the latter cannot be used up by the diatoms.

The hydrography of the English Channel is discussed by Mr. Matthews in a short paper of great general interest. An account, illustrated by charts, of the salinity and temperature variations during the year 1906 is given, and the author then discusses the results of calculations of the mean salinities during the years 1903–9. He shows that in addition to the annual salinity variation, there is a two-yearly periodic change, of such nature that the "even" years are characterised by a high range of salinity variation, while in the "odd" years the range of variation is low. The annual and biennial periods are superposed on a longer one, probably twelve-yearly. These discussions anticipate a further paper, which promises to be one of very great interest.

J. JOHNSTONE.

A ONE-VOLUME NATURAL HISTORY.[1]

TO compress even a sketchy account of the leading types of existing animals into a small octavo volume of just over 560 pages, and that illustrated by a number of relatively large figures, is a task of stupendous difficulty. In the present instance the author has increased the difficulty by introducing—

FIG. 1.—A Chinchilla. From the "New Illustrated Natural History."

probably in accordance with what I believe to be a mistaken notion on the part of publishers—a number of anecdotes, which merely waste space. This may perhaps account for the very imperfect diagnoses of most of the groups and species, which appear in many cases insufficient for their identification by those who

1 "New Illustrated Natural History of the World." By E. Protheroe. Pp. xx+564. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

are not naturalists, and for whom alone the volume is intended. As is usual in works of this nature, vertebrates claim the lion's share of the volume, the lower groups being accorded only sixty-eight pages, which is, of course, an altogether inadequate proportion of space.

Nevertheless, Mr. Protheroe has succeeded in producing a readable, and certainly a remarkably well illustrated volume, which is calculated to attract a large circle of readers. With the exception of the twenty-four coloured plates, the illustrations are from photographs, some of which are naturally better than others. In some instances the photographs, like the one of a tur (p. 169), are taken from immature specimens, which convey no idea of the adult animal. In other cases, as in the so-called Canadian skunk

FIG. 2.—A Marabou Stork. From the "New Illustrated Natural History."

(p. 95) and dwarf buffalo (p. 162), animals are wrongly identified; while in the figure of a wild ass (p. 155) the reader is left to discover for himself whether it is intended for an Asiatic or an African species, and there is no reference in the text to the figure of an "Australian Rail" on p. 366. As regards the coloured plates, it will perhaps suffice to say that while some are excellent, the others are probably the best that could be produced for the money; but in the figure supposed to represent the black rhinoceros it seems as if the artist had made a "composite" portrait of the African and the great Indian species. Two photographs are reproduced as samples.

As regards the text, this, in addition to much more or less irrelevant matter, is marred by a large number of omissions and errors, of which only a few, and these in the sections on mammals and reptiles, can be mentioned here. In the Insectivora, for instance, no mention is made of Chrysochloridæ, Gymnurinæ, Solenodontidæ, or Potamogalidæ, while the Centetidæ are intercalated between Tupaiidæ and Macroscelididæ, and the reader is left to find out for himself the genus name of the typical representatives of the latter. Space for these omissions might have been found by cutting down the account of monkeys. Among the rodents, Pedetes is still classed with the jerboas (p. 126), and is said to be "a very similar species," while American porcupines are not separated as a family from their Old-World relatives.

Passing to ungulates, it may be noted that Grévy's zebra (p. 156) is stated to range "the Victoria Nyanza regions," whereas its habitat is east and north of that lake; and that not a word is said with regard to the range of the white rhinoceros (p. 152). On p. 169 we are informed that the Alpine ibex is "the most probable forbear of the common goat," and on p. 171 that the takin "is a native of the highest and least-known regions of Tibet." Perhaps, however, the worst misstatement in the book occurs on p. 241, where it is asserted that the opossum family is "remarkable among the marsupiated animals, because it is the only one that is not Australian." Has the author never heard of Cænolestes?

Among the reptiles it must suffice to state that there is no mention of Schlegel's gharial, that the reader is left to find out for himself what part of the globe is the home of the Chelydridæ (p. 404), and that it is scarcely true to say that the tuatera has teeth on the palate (p. 428).

Although the book has merits, I am driven to conclude from the foregoing and other instances either that the author is terribly careless, or that he is not up to his work.

R. L.

PROF. JOHANNES BOSSCHA.

THE career of this eminent physicist has not only been of importance for the advancement of physics, but also of the greatest benefit to the development of exact science in Holland. Born on November 18, 1831, at Breda, Bosscha was initiated in physics by van der Willigen, and entered the University of Leiden in 1850. His eminence as a student in different respects foreshadowed the leading position he occupied in later life. In Bosscha's later observational work the influence of the great astronomer Kaiser is evident. In March, 1852, he took his degree with a dissertation on the differential galvanometer, worked out in the Physical Laboratory at Leiden, then under the direction of Rijke. After a short stay at Berlin, he returned to this laboratory as assistant. Attention was soon directed to him by the vigorous part he took in the great scientific movement in connection with the law of conservation of energy. The most important problem dealt with in his well-known papers on the mechanical theory of electrolysis is the test of Kelvin's calculation of the electromotive force of a galvanic cell from the heat developed by the chemical processes which accompany the current. By determining in absolute measure the electromotive force of the Daniell cell, he contributed to the work which ultimately led to the adoption of the C.G.S. system of electrical units. He gave a solution of multiplex telegraphy, and several rules

and methods introduced by him have passed through the text-books into the electrotechnic practice.

In the time that separates this period of experimental activity from its resumption in 1873 fall ten years devoted to the organisation of secondary education and the reorganisation of the higher technical instruction in Holland, which have proved a great boon to the country. The secondary schools have spread enlightenment everywhere, and, providing everywhere the preparatory instruction necessary for attending the polytechnicum, they laid the foundation for the development which technics have taken in Holland. Equipped as they were by Bosscha's influence with physical and chemical laboratories, they have since attracted to science the greater number of the men of the present generation that have devoted their life to it. Though absorbed in this very successful organising work, Bosscha found time for his discussion of Regnault's measurements, which added much to the value of these classical researches.

Professor since 1873, and director of the Polytechnicum at Delft since 1878, Bosscha found the opportunity to continue his efforts for the reorganisation and development of this institution. He was foremost among those who raised its status to that of a technical university, what it afterwards became officially. Bosscha's clear and fascinating lectures live in the grateful memory of broad circles of his pupils. He was the acknowledged master in criticism of experimental methods. To have felt the influence of his insight, inspiration, and high aims was to be full of admiration and gratitude for one's life. The main scientific work undertaken by Bosscha in this period was in relation with the new Dutch standard metres; an investigation of Fizeau's focussing method was the starting point for a study which led him to the development of a complete theory of centred optical systems. The series of Bosscha's metrological researches will always be regarded as a masterpiece of scientific work of precision.

To uphold Holland's honour in the domain of science was Bosscha's constant aim all his life. Having accepted in 1885 the secretaryship of the Dutch Society of Sciences at Haarlem, he became the soul of this institution. His manifold occupations—it will suffice to mention the reorganisation of the Dutch Meteorological Service—were all directed to the promotion of science, the extension of its influence, and the increase of sympathy for Dutch science abroad. Working to the end of his life with unimpaired power of thought, vivacity of appreciation, and glowing love for what was right, serving science with his enthusiasm and eloquence, he was always honoured by the Dutch physicists as their leader. The last years of his life were devoted to the edition of Huygens's correspondence and works. To his literary talents and his passionate love for historical justice we owe many vivid pictures of past scientific life. As to Huygens, it may be said that he was resuscitated by Bosscha, and no less talents than his were needed to get all from Huygens's hand presented to the scientific world in a form corresponding to Huygens's greatness.

Bosscha's increasing veneration for Huygens was well in harmony with his own searching love for truth, his aristocratic turn of mind, and his profound sense of beauty. He combined great courage and force of mind with an almost childlike simplicity and trustfulness and an infectious optimism. We lose in him a noble, frank character, and a friend to whom one never went without being warmed by his kind affection and stimulated by his faith that the future belongs to the great ideas.

H. KAMERLINGH ONNES.

NOTES.

DR. FREDERIC A. LUCAS has been appointed to succeed Dr. H. C. Bumpus as director of the American Museum of Natural History, New York, and will take office on June 15. The new director, who is now in his sixtieth year, has been chief curator of the Brooklyn Institute of Arts and Sciences since 1904. He had previously served for twenty-two years in various posts in the U.S. National Museum at Washington. As an author he is best known for his books and papers on palæontology and comparative anatomy, as well as on museum methods.

PROF. UGO MONDELLO, director of the geophysical observatory at Leghorn, has accepted the post of director of the Observatorio Regional do Rio Grande do Sul, Brazil.

LORD CURZON OF KEDLESTON has been elected president of the Royal Geographical Society in succession to Major Leonard Darwin. Captain H. G. Lyons, F.R.S., has been appointed one of the honorary secretaries, and Sir G. D. Taubman Goldie, F.R.S., the foreign secretary, of the society.

THE Hanbury medal of the Pharmaceutical Society for 1911 has been awarded to M. Jean Eugène Léger, of Paris. The new medallist is chief pharmacist to the Hôpital St. Louis at Paris, and a member of the committee of revision of the French pharmacopœia.

DR. J. G. FRAZER (author of "The Golden Bough," &c.) has been elected a member of the philosophical-historical section of the Royal Academy of Sciences of Berlin.

WE regret to have to record that at the Paris-Madrid aëroplane race at Issy-les-Moulineaux on Sunday last a deplorable accident occurred, causing the death of M. Berteaux, the French Minister of War, and severe injuries to M. Monis, the French Prime Minister. It appears that one of the competitors in the race, M. Train, finding that neither the engine nor rudder of his machine was working satisfactorily, decided to descend, and in endeavouring to avoid coming into contact with a detachment of cuirassiers and the spectators, dashed into the group of Ministers and their party, who only came into the aviator's view as the cuirassiers rode clear of the group, with the lamentable result given above.

WE announce with deep regret the death, on Saturday last, at the age of eighty-seven years, of Dr. N. Story-Maskelyne, F.R.S.

WE regret to notice the death, which took place on Monday last, of Mrs. W. P. Fleming, the curator of astronomical photographs at Harvard.

THE death is announced of Prof. B. Peter, for many years the first assistant at the Leipzig Observatory. Prof. Peter was born at Weida, in Saxe Weimar, in 1853, and studied medicine at the University of Jena, but his liking for mathematics and natural science led him to accept a position, under Prof. Karl Bruns, at the Leipzig Observatory in 1876. Six years later he was advanced to the position of first observer, and in 1899 was named professor of practical astronomy, holding both posts until his death.

MR. ROBERT SERVICE, who has just died at Dumfries, was one of the best naturalists in Scotland. His profession of nurseryman and seedsman prevented his attending a university, and also involved close attention to business for every working day. Nevertheless, he knew intimately the haunts of every bird in the south of Scotland. Not only so, but he thoroughly understood

mammals, fishes, Amphibia, and reptiles. He was an excellent entomologist, and took an especial interest in bees and the larger Diptera. Most unfortunately, his published papers represent but a very small part of this wide acquaintance with birds and beasts of all kinds. He was never able to afford the heavy cost of publication which must, for some inscrutable reason, always be incurred in Great Britain if a book is of a scientific nature. Much of his work is included in the recent "Birds of Dumfriesshire," by Mr. H. S. Gladstone, but by far the greater part of it is lost. It is by no means unusual for working men to be real naturalists, at least in Scotland; but Robert Service was far more scientific, and had a far wider knowledge than even Edwards and Dick, whose names are known to the general public. He managed somehow to keep abreast of modern authorities, in spite of the difficulties involved by residence in a small country town. His death is a serious loss to the natural sciences in the south of Scotland, and under present conditions it is a loss that cannot possibly be repaired.

The Times announces that enough money having been raised by subscription for the erection of a statue to Captain Cook, permission has been given for the statue to be placed on the Mall side of the Admiralty arch, at the end of the Processional road, on the right hand going towards Charing Cross, and the execution of the statue has been entrusted to Sir Thomas Brock, K.C.B., R.A.

According to *The Pharmaceutical Journal*, a statue to the memory of Priestley is to be erected in the market-place of Birstall, the town of his birth.

The committee of the Robert Koch memorial endowment for the encouragement of research in the subject of tuberculosis has decided to give grants to Prof. Schieck and Dr. Krusius for investigations on tuberculosis of the eyes, to Dr. Weinberg for statistical inquiries relative to tuberculosis, and to Prof. Gaffky for the continuation of his researches. Since the year 1908 the sum of 3600*l.* has been expended by the committee in scientific work.

The new Research Institute of the Cancer Hospital was opened on Tuesday by the Duke of Connaught, who said he hoped that the institute might be the forerunner of wonderful discoveries in combating the disease of cancer, and that success would be the result of the labours of those who should engage in research.

The conversazione of the Royal Society of Arts will be held on Tuesday next—May 30—in the galleries of the British Museum (Natural History), from 9 p.m. to 12.

On Tuesday next Prof. W. W. Watts will deliver the first of two lectures at the Royal Institution on "Charnwood Forest: its Ancient Volcano and its Fossil Landscape"; on Thursday, June 1, Mr. T. Thorne Baker begins a course of two lectures on (1) "Changes Effected by Light," (2) "Practical Progress in Wireless Telegraphy"; and on Saturday, June 3, Dr. W. L. Courtney begins a course of two lectures on "Types of Greek Women." The Friday evening discourse on June 2 will be delivered by Commendatore G. Marconi on "Radiotelegraphy," and that on June 9 by Prof. Svante Arrhenius on "Applications of Physical Chemistry to the Doctrine of Immunity."

The fifty-fourth general meeting of the Institution of Mining Engineers will take place on Thursday, June 1, in the rooms of the Geological Society. The following papers are announced for delivery:—A flame test for the estimation of oxygen and black-damp in naked-light mines, by Dr. J. S. Haldane, F.R.S.; An experiment on the effect of reversing the main air-current, by Mr. J. Bain and Dr. J. S. Haldane, F.R.S.; Notes on contrivances designed to prevent over-winding, with some instances of their failure, by Messrs. W. H. Pickering and G. Poole; The Otto-Hilgenstock direct-recovery process and its application, by Mr. E. Bury. The following papers, which have already appeared in the Transactions, will be open for discussion:—The mining school at Bochum, Westphalia, by Prof. H. Louis; Progress in the use of exhaust seam-power, by Mr. J. Burns; The Elliott-Jones vertical coke-oven, by Mr. T. C. Futers.

An International Rubber and Allied Trades Exhibition will be held in the Royal Agricultural Hall from June 24 to July 14, and on July 3 there will be a rubber conference at which the many problems in connection with the industry will be discussed.

The eighth International Congress of Applied Chemistry is announced to be opened, at Washington, by the President of the United States on September 4, 1912; the further meetings of the congress will be held in New York from September 6 to 13. The congress will be divided into twenty-three sections and subsections, and papers intended for presentation or publication should reach the American committee not later than July 1, 1912.

The preparations of the German Antarctic Expedition were completed at the beginning of May, and on May 7 the *Deutschland* sailed from Bremen. Lieut. Filchner will join the ship in Buenos Ayres in four months' time, whither additional stores and equipment are also being sent. The general plan is to enter the Weddell Sea to the south of South America, and endeavour to establish the relation of the masses of land lying east and west of the South Pole. Great importance is attached to the installation of a land station and its maintenance for so long a period as possible. From this point geographical, geological, astronomical, magnetic, meteorological, and biological work will be carried on by the staff of eleven members of the expedition, who will be here quartered. Four of them will make a dash for the South Pole with Nansen sledges. The ship, the *Deutschland*, is a converted whaler with auxiliary steam of about 300 horse-power, and has been especially fitted with a view to the comfort of the explorers. She is equipped with a wireless telegraph installation, and is taking out three motor vehicles and one motor boat, since motor transport is to be largely employed, though both dogs and Manchurian ponies are also to be utilised.

Speaking in the House of Commons on Wednesday of last week on the Budget proposals, Mr. Balfour asked the Chancellor of the Exchequer to exercise caution in carrying out his scheme for the expenditure of large sums of money on building consumption sanatoria. In the public mind, he said, there had perhaps been an exaggerated enthusiasm for this method of dealing with tuberculosis. There was an idea that this open-air treatment had produced such marvellous results that through it alone tuberculosis could be, if not exterminated, at all events diminished to such an extent that it might be reduced to one of the rare zymotic diseases. He was not sure that the most recent investigations bore out that view. There were very able investigators who took the view, after examining the actual results in this country and in Germany, that so many complete cures must not be expected as was at one time hoped for. He took a sanguine view as to the treatment of tuberculosis, for he believed that science had made great strides and was still destined to make great strides, but

when they came to such large sums as those mentioned by the Chancellor of the Exchequer, it was possible to waste money on permanent buildings which might be better devoted to scientific investigation into the cause of the disease. They must not assume that all that they had to do was to spend money on these sanatoria in order to effect a cure. What was important was that medical science had made great progress, and we required further investigation and perpetual study as to how these people were to be treated when in the sanatoria. One of the greatest benefits, perhaps, of establishing these sanatoria would be in giving expert medical authorities the opportunity of carrying on investigations which would enable them in the future to deal with this disease in a way they were not able to do at present. In reply, Mr. Lloyd George said he agreed that the important thing was to encourage scientific investigation, so as to arrive at the best methods of cure. That was provided for in his Bill. There would be set aside a special fund for the purposes of scientific research. The Government would make use of and assist existing sanatoria, those which had been maintained by voluntary contributions, and even those which were built by private enterprise.

At a meeting of pathologists interested in medical museum work, recently held at the Royal College of Surgeons of England, for the purpose of receiving information upon the International Association of Medical Museums, and with a view to extend the membership and general usefulness of that body in Great Britain, the following resolutions were passed:—(1) That after the arrangements for the meeting of the International Congress of Medicine at London in 1913 are completed, steps shall be taken to arrange for a meeting of the International Association of Medical Museums in conjunction with this congress. (2) That the three great English medical societies, namely, the Pathological Society of Great Britain and Ireland, the Anatomical Society, and the Royal Society of Medicine, be made cognisant of the action of the International Association of Medical Museums, and that cooperation with these societies be attempted with special reference to the publication in their journals of the Department of Exchanges, as well as announcements and short reports of meetings. (3) That one or more correspondents in London be appointed to act as local secretaries.

The Entomological Society of London held a Conversazione on Wednesday, May 17, in the rooms of the Linnean Society, which had been kindly lent for the purpose. The exhibits were very varied, and there was much to interest the non-entomological as well as the scientific portion of the assembly. The "livestock," including Observation Nests of ants with various myrmecophilous insects, shown by Messrs. Donisthorpe and Crawley, larvæ and pupæ of British Lepidoptera by Mr. Newman, fleas with ova, larvæ, and cocoons by Mr. Bacot, and "stick insects" in every stage of development by Mr. Baldock, were a constant source of attraction. Many fellows exhibited interesting and attractive insects of various orders, including eight drawers of mimetic Lepidoptera brought by Prof. Poulton, the three newest European butterflies (*Callophrys avis*, *Pieris manni*, and *Erebia palarica*) by Dr. Chapman, the pick of the results of thirteen years' breeding of *Angerona prunaria* by Mr. Pickett, and a wonderful drawer of gynandromorphs from the Tring Museum. There were several microscopic and photographic exhibits, Mr. Main's stereoscopic photos and Mr. Enock's Mymaridæ deserving special mention, while further variety was secured by Mr. Eltringham's and Mr. Wheeler's water-colour drawings of butterflies, Mr. Prideaux's method of scale-transference, Prof. Image's interesting books, including Stainton's annotated copy of Wood's "Index Entomologicus," the Obligation Book of the Society with its many interesting autographs, and the various relics of Linnæus exhibited by the Linnean Society. During the evening lectures were given, with lantern illustrations, by Prof. Poulton on "Recent Discoveries in Insect Mimicry," and by Mr. Enock on the Tiger Beetle (*Cicindela campestris*).

A communication has been received from the Decimal Association directing attention to a recent report of the council of the British Medical Association with reference to the adoption of the metric system of weights and measures by medical practitioners. This report recommends that both the theoretical and the practical instruction of medical students in pharmacology and materia medica should henceforth be according to the metric system. As regards practitioners who have been trained in the imperial system of weights and measures, the suggestion is put forward that a transitional procedure should be adopted which, while immediately introducing some of the advantages of the metric system, would also facilitate the change from the old system to the new at a later date. Cooperation with pharmacists will be necessary in order to deal with cases where prescriptions are given to be made up by any chemist the patient may choose. It is recommended that the local divisional bodies should, after ascertaining that medical opinion in their district is ripe for the step, arrange a conference with the local pharmaceutical association in order to arrive at a mutual understanding in the matter.

Mr. P. W. Stuart Menteath continues in *Biarritz-Association* his somewhat controversial papers on "Les Gisements metallifères des Pyrénées Occidentales." Despite the title adopted, the work is mainly directed against the too hasty adoption of the theory of recumbent overfolds as an explanation of the facts of mountain-structure. Numerous sections illustrating the author's observations are given in the third part (March, 1910). The fifth part (March, 1911) criticises the views of Pyrenean structure held by M. Dalloni; but the arguments are marred by a certain obsession in regard to "Darwinisme," the evolutionary theory being held responsible for most of the errors of geologists. Perhaps the same obsession explains a mysterious allusion, at the conclusion of part iv., to the reduction of our "facultés légitimes à celles des singes et des perroquets." Where the author emphasises the effects of ramifying igneous injections, associated with mineral veins, in inducing metamorphism, he seems to be on more serious and surer ground.

The *Geologische Rundschau* continues to provide admirable essays on current work and problems in geology, in addition to original papers. The "Besprechungen" themselves are original, in that they consist of critical reviews by specialists. H. Potonié brings together his own results under the head of "Kaustobiolithe" in part vi. of the first volume, p. 327 (December, 1910). In the following part (March, 1911), R. Lepsius urges that the high watershed in Scandinavia lay to the east of the present one in glacial times, and thus allowed of the recognised movements of the ice. He does not approve of the theory of the ice-dome, and prefers to rely on considerable warping and faulting of the country to account for its present general contour and the basins of many of its lakes. Critics may point out the evidence that exists in Jämtland and

elsewhere of the movement of ice over obstacles rising 1000 metres or more above the glaciated valley-floors. W. von Seidlitz describes in the same number the adventurous excursion organised by Axel Hamberg for five members of the International Geological Congress of 1910. The six geologists, in visiting the Sarek Mountains in Lapland, required a train of six Lapps and twenty-four reindeer. The masses of crystalline rocks overthrust on Silurian strata proved of special interest. In volume ii., part ii. (May, 1911), O. A. Welter notices seventy-three recent papers on nephrite.

The fourth annual meeting of the American Peat Society was held in Ottawa in 1910, and the proceedings are recorded in full in the journal of the society issued for January, 1911, and published at Toledo, Ohio. The members look to the future rather than to the present; but the rapid consumption of coal-supplies gives a patriotic importance to those who try to develop the use of peat. Of course, the manufacture of ammonium sulphate also comes under consideration. The Canadian Department of Mines has issued a second edition, with maps and engineering drawings, of Bulletin No. 4, on the "Investigation of the Peat Bogs and Peat Industry of Canada during the season 1909–10." The author is Mr. A. Anrep, jun., peat expert, and valuable papers are translated from foreign sources. That on the Ekelund process for drying powdered peat at a high temperature is likely to attract the most attention.

Mr. C. D. Walcott has carried the history of the indubitable Merostomata back into Middle Cambrian times (Smithsonian Miscellaneous Collections, vol. lvii., No. 2, April 8). Two new genera, Sidneyia and Amiella, are described by him from the Rocky Mountains near Field, on the Canadian Pacific Railway, and are the result of a laborious and systematic examination of the strata. Both genera fall into a new sub-order of the Eurypterida, the Limulava, with four pairs of cephalo-thoracic appendages and simple antennæ, in this resembling the trilobites. Beltina, the fragmental pre-Cambrian form regarded as a Merostome, receives further discussion and illustration, but Redlichia, of the Lower Cambrian of Indo-China, is styled "the oldest Merostome now known."

Museums in America are in the fortunate and enviable position of being able to draw, in addition to their regular State grants, large pecuniary contributions from private benefactors. In the report for 1910, the American Museum of Natural History acknowledges its indebtedness to this source of revenue, the president remarking that while the "income from endowment has not materially increased, the total gifts towards exploration and exhibition exceed those of any previous year in the museum's history." Even so, the financial resources appear unequal to the demands upon them, for it is further stated that "the addition of three new departments since 1907, namely, of Living Fishes and Reptiles, of Woods and Forestry, and of Public Health, has made serious demands upon our income. . . . Thus the increased endowment afforded by Mr. Jesup's bequest, which cannot by its terms be used for any item of maintenance, is offset by these increases." Among the additions to the exhibited collection, mention may be made of a group of Pribilow sea-bears, of which a photograph is given in the report. A special feature of the year was the unusual number of collecting expeditions, of which there were ten to various parts of the United States and fourteen to other territories.

In *The Field* of May 13 Sir Ray Lankester gives, under the title of "The Earliest Picture in the World," an illustrated description of a cylinder of stag's antler found in 1875 in the cavern of Lorthet, near Lourdes, Haute Pyrénées, on which are incised figures of three red deer and several salmon-like fish. The specimen belongs to the Elaphotarandian epoch, when the Arctic fauna was being replaced by the animals characteristic of modern Europe. The author gives a flat picture printed off from the cylinder, and adds two restorations of the missing portions of the figures of the deer. In his opinion, the prehistoric engraver worked from a similar flat picture, and it is further suggested that incised cylinders of this type were used by their makers as "blocks" from which to print impressions on birch-bark and other suitable materials.

To *The Times* of May 15 Dr. Shipley communicates a letter on the so-called "eale" or "yale," in which it is pointed out that the original account was given by Pliny, from whom Topsell seems to have derived the materials for a fuller notice in 1607. These accounts present the animal in a somewhat different guise from those previously quoted. It is described as of the size of a hippopotamus, with an elephant's tail, a black or tanny colour, the jaws of a boar, and two horns, which could be moved independently of each other, of more than a cubit in length. Topsell adds that it was fond of water. Its home was Ethiopia. If the statement as to its size be trustworthy, the only animal that would accord with the description would be an African rhinoceros; and we believe there are legends as to the mobility of the horns of the latter. On the other hand, rhinoceroses were known to the ancients. Whatever be the truth on this matter, it seems impossible to identify the antelope-like or goat-like animals in the arms of Christ's College with Pliny's eale.

According to the report for 1910, the Natural History and Polytechnic Society of Bootham School, York, continues to attract a satisfactory number of working members, the natural history section including sixty-five scholars. Meetings and excursions were held from time to time, and the admirable practice of inducing the members to keep diaries, based on actual observations, has been continued.

The hon. secretary of the Selborne Society informs us that the nesting boxes made from natural logs which the society introduced at the beginning of the year have been very successful. In some cases correspondents (who number well over seven hundred) have had all the boxes which they have put up tenanted, and a special experiment made in the Brent Valley Bird Sanctuary has resulted in possession being taken of all but one of the boxes concerned. The committee of the society has arranged an exhibition of the boxes in the science section of the Coronation Exhibition, and photographs of the boxes, showing the nests within and the birds sitting, will be published in "The Country Home" for June.

The report of the advisory committee for the Tropical Diseases Research Fund for the year 1910 (Cd. 5514, 128 pp.) shows that the campaign against these diseases is being prosecuted vigorously from the several aspects of prophylaxis, treatment and research into the structure, life-history, and modes of transmission of the causal organisms. Prof. Ross and Dr. Thomson have shown that, by the use of improved methods, malarial parasites can be found in the blood in the apyrexial periods, occurring in numbers so small as 20 per cubic mm. Relapses are thus explicable as the result of the usual mode of increase in the number of such parasites; the presence of crescents reproducing parthenogenetically is not essential for the production of a relapse. Dr. Wenyon has given

an account of his investigations, carried out at Bagdad during the summer of the past year, on Oriental sore; his experiments indicate that Stegomyia is under suspicion as the transmitter of this disease. Numerous other important researches, completed or in progress, are reported upon, *e.g.* by Prof. Minchin on trypanosomes and fleas, Dr. Woodcock on Halteridium, Dr. Castellani on a type of bronchitis common in Ceylon, and due apparently to the attack of a new species of the fungus Oidium, Drs. Fraser and Highet and others on beri-beri in the Malay States and Siam.

To the Bulletin of the Johns Hopkins Hospital for May (vol. xxii., No. 242) Dr. Pearce Bailey contributes an article entitled "A Florentine Anatomist." This is no other than that versatile genius Leonardo da Vinci, who planned to write a treatise on anatomy in one hundred and twenty volumes, and left note-books rich in drawings with marginal explanations, and he was the first to acquire an accurate knowledge of descriptive anatomy. A short biographical sketch of Sir Richard Owen is also contributed by Dr. Rohrer, with four characteristic portraits and an illustration of Sheen Lodge, where his last days were passed.

THE catalogue of additions to the library and the list of new garden plants of the year 1910 have been issued as Appendix II. and Appendix III. to the current volume of *The Kew Bulletin*. In the former the printing is confined to one side of the page, so that the titles may be cut out and used as index slips; the latter provides an authentic list of correct names. As in recent years, an outstanding feature of the new garden plants is the predominance of Chinese novelties, although, except for eight species of Rubus, the additions are scattered through numerous genera; the introductions traceable to Mr. E. H. Wilson's last journey are beginning to arrive through the Arnold Arboretum and other sources. Several fine orchids have, as usual, been introduced by Sir Trevor Lawrence; among those which gained botanical certificates were *Megaclinium fuscum* and *Polystachya paniculata* from Africa, and *Dendrobium karoense* and *Bulbophyllum polyblepharon* from New Guinea.

A NUMBER of new records of flowering plants and ferns for the National Park, Wilson's Promontory, Victoria, are noted by Mr. J. W. Audas in *The Victorian Naturalist* (vol. xxvii., No. 11), which raise the total to 600 species. Amongst them are species of Pterostylis, Xanthosia, and Hydrocotyle, an uncommon creeper, *Myriophyllum amphibium* and *Selaginella Preissiana*. The list includes some apparent aliens, such as *Fumaria officinalis, Nasturtium officinale*, and *Spergularia rubra*. Several plants were noted as rapid colonisers on burnt ground, of which *Burchardia umbellata* was the most conspicuous. A succulent form of *Stackhousia umbellata* was found on the beach where the crimson and occasionally white-flowered *Kennedya prostrata*, the "running postman," attracted attention; on the sand dunes, the grasses *Spinifex hirsutus* and *Festuca littoralis* proved their value as efficient sand binders.

AN interesting report on the progress of agriculture in India is issued from Pusa. The improvements in cotton-growing are now making themselves felt in many thousand acres of the great cotton areas in the presidencies of Bombay and Madras and in the Central Provinces, while the plant-breeding work of the United Provinces seems likely materially to improve the crop there. Special mention is made of the wheat-breeding experiments, which have now reached considerable dimensions, and have resulted in the production of varieties better in quality than anything yet grown in India. Progress is also recorded in the reclamation of the salt lands of Sind, and in the rigorous campaign against the palm disease in the Godavery delta, which has resulted in the saving of lakhs of rupees every year. Progress in agricultural education has, however, been slower than in investigation, but the cause is not far to seek—colleges have had to be built and staffs collected before much could be done. But the beginning is made, and good work may be looked for here also.

WE have received copies of the South African National Union Journal, the organ of a society having for its object the encouragement of South African industries. A number of articles are published showing the products that South Africa can supply for which there is a good market, and we note that stress is laid on the importance of keeping up the supplies of maize and of bacon. Mr. Burtt Davy writes on the value of peanuts for human food, and argues that, for the strict fruitarian, peanuts are not only the cheapest, but also the best source of energy.

THE opening up of British West Africa is dealt with at some length in No. 4 of *Tropical Life*. The five colonies S. Nigeria, N. Nigeria, the Gold Coast, Lagos, and Sierra Leone can, it is claimed, produce nearly every important tropical product except perhaps tea and sugar. Much, however, is needed in the way of organisation; trade routes are needed, land laws require amending, and labour supplies have to be arranged. An association has recently been formed with the object of accomplishing some of these objects.

WITH characteristic thoroughness, the Americans are introducing agricultural education into the Philippines. It is less than two years ago that the first agricultural college was started at Los Baños with twelve students, the classes being held in tents, with no appliances, not even blackboards, at first, and with so few seats that the students had to carry their stools about with them. Now it has a hundred students, laboratories, and class-rooms, and by next year will have accommodation for five hundred students. We have received the first two numbers of its journal, *The Philippine Agriculturalist and Forester*, published by the "student body" of the college, and containing interesting accounts of agriculture as it now is, and of possible improvements on present methods.

IN the year 1907 the Jamaica Weather Service, which had been dormant for some years, was resuscitated and associated with the United States Weather Bureau, which placed at its service an electrical recording anemometer by Friez, designated a "triple register." The Kingston Observatory has now published the results of wind direction and velocity between August, 1908, and July, 1909, for each hour and month. The tables show in all months a gradual increase in velocity from midnight to 1h. or 2h. p.m., followed by a decrease. Another prominent feature of the diurnal range is the sudden decrease for a little time just after sunrise, owing probably to the gradual disappearance of the land breeze. By extracting the number of miles from each direction, it is shown that 51·2 per cent. of wind comes from the S.E., and 23·9 per cent. from the north (land wind). The average hourly velocity of the former is 11·2 miles, of the latter only 4·0 miles. The annual resultant derived from the hourly components is E.S.E. ¼ E. 2·5 miles per hour. During the period under review the greatest hourly velocity was 30 miles (factor 3).

AN average rainfall map with isohyets of Victoria compiled from yearly records available for a period of 15 years

and upwards has been received from the Central Weather Bureau at Melbourne. It has been drawn to the same scale as that of New South Wales (published last year), the two forming a comprehensive and valuable rain-chart of the south-eastern portion of Australia. The average rainfall of Victoria is 27·19 in., ranging from 10·80 in. in the Mallee district (north-west) to 68·75 in. in Cape Otway Forest district (south). The map shows an approximate distribution as follows:—40–> 60 in. over an area of 12 thousand square miles; 20–40 in. over $43\frac{1}{3}$ thousand, and < 15–20 in. over $32\frac{1}{2}$ thousand square miles. The great influence of proximity to the mountains and seashore is plainly shown; the abundant rains on the Australian Alps, Cape Otway, and Gippsland ranges being particularly conspicuous.

IN a paper read before the Royal Photographic Society, Mr. Chapman Jones dealt with the relationship between the size of the particle and the colour of the image in the case of lantern-slides developed to show a coloured deposit. The author referred to Zsigmondy's statement that the colour of colloidal solutions has no direct dependence upon the size of the particle, and his suggestion that the cause of the colour is not to be sought for in the sizes of the particles, but rather in the distances between them. Mr. Chapman Jones has investigated the matter, not by the usual ultramicroscopical method, but by enlarging the particles by mercurial intensification. Mercury is added in definite proportions by treating the film containing the particles first with mercuric chloride and then with a ferrous oxalate developer, each treatment adding one atom of mercury to each atom of silver, or of silver and of mercury that is present, the linear enlargement for eight enlargements, the maximum employed, being 7·134. The enlarged particles were then measured by means of a microscope and eye-piece micrometer, the accuracy of measurement being about 5 per cent. The results obtained showed that films that gave the same colour contained particles of approximately the same diameters, particles below 0·10 micron giving no visible colour; particles from 0·10 to 0·13, yellow; from 0·14 to 0·17, orange; from 0·17 to 0·19, pink, brown, or purple; and particles above this size, grey. No connection between the distance apart of the particles and the colour was found, but a measurement of the refractive index of gelatin and calculation of the half wave-length of light in gelatin, showed that the size of the particle giving a definite colour could be taken to correspond approximately with the half wave-length of light the absorption of which would give that colour, the particles being rather smaller than the calculated half wave-lengths. The authors conclusions are that the size of the particle is the determining factor in selective scattering, and that light is scattered by particles that approximate in diameter to half a wave-length of the scattered light.

Himmel und Erde for April 29 contains an article by Prof. B. Donath, of Berlin, on the gyrostat and its technical future. After explaining the precessional motion of a gyrostat by means of the ordinary toy, Prof. Donath gives an account of Schlick's application of the gyrostat to the diminution of the rolling motion of ships, and hints that a similar device may in the future form part of the equipment of the aëroplane. The greater part of the article is devoted to the applications of the gyrostat to mono-rail transport by Brennan and by Scherl, and to the gyrostatic compass by the brothers Anschütz. In the case of the compass, the theory is clearly explained, and views of the various parts of the instrument are given. The author is naturally optimistic as to the future of the compass, but expresses himself more guardedly as to that of the mono-rail.

THE opportunity for the dissemination of nature knowledge offered by the boy scout organisation should not be lost sight of by those who desire to see the study of natural phenomena become more popular in the future than it has been—unfortunately for us and for our boys and girls—in the past. A lecture recently delivered in Leeds by Mr. Elgie was, according to *The Leeds Mercury*, attended by some 400 of the scouts, who paid enthusiastic attention to the lecturer's instruction as to the apparent movements of the stars, their grouping in constellations, and the simpler methods by which geographical direction may be ascertained from observation of the heavens. These same subjects are, we understand, also dealt with by Sir Norman Lockyer, in an additional chapter, in the new edition of his "Primer of Astronomy"; in this chapter the author shows the disposition of the most easily recognised asterisms throughout the year, so that the scout may, on recognising any group of stars, determine at once the cardinal points, and so find his direction. Workers in other fields of science, *e.g.* geology, botany, &c., might usefully give a little time to the simple instruction of the young people already so admirably organised by the general movement.

The Cairo Scientific Journal for April contains a paper on work under compressed air at the Boulac Bridge, read by Mr. Arthur J. Knowles before the Cairo Scientific Society on March 2. The Nile at Boulac is very deep; in places there are more than 66 feet of water at low Nile. The number of men who actually worked in compressed air during the sinking of the piers and abutments of the bridge was 493. One hundred and fifteen cases of illness were dealt with by the doctor, one man being attacked three times, thirteen men twice (one fatally), and eighty-six men were attacked once (three fatally). One case resulted in total deafness, four were fatal, and the remaining cases completely recovered. Two of the fatal cases were due to the heart and circulatory system, one to the lungs, and one to hæmorrhage of the spinal marrow. The majority of the cases were of pains, cramp, slight palsy, and temporary paralysis of limbs and joints. The labourers were all natives of Egypt, supervised by Europeans, but the latter were not in the compressed air for such long periods as the labourers. The author regrets the non-provision by the contractors of a medical air-lock, into which men suffering from the effects of too rapid decompression can be put and recompressed. This remedy is almost universal in English and American practice, and has been attended with great success.

THE Cambridge University Press announces for early publication in the series of "Cambridge Manuals of Science and Literature" "Aërial Locomotion," by Messrs. E. H. Harper and A. Ferguson, and "Electricity in Locomotion," by Mr. A. G. Whyte. The first-named work will contain an introduction by Prof. G. H. Bryan, F.R.S., and chapters on general principles, propellers and motors, stability and control of aëroplanes, model aëroplanes and gliders, aëroplanes, dirigibles, &c., and Mr. Whyte in his volume will give an account of the application of electricity to locomotion and show the present condition of affairs and the developments which may be looked for in the near future. There are to be chapters on the mechanism of the overhead and of the "stud" systems, on electric railways and on electric traction on main line railways. There will also be a discussion of petrol-engine electric power.

THE age of Sir Nathan Bodington, given in NATURE of last week as eighty-two, was sixty-two years.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 1. 5h. 0m. Mercury at greatest elongation W. of the Sun (24° 30′ W.).
6. 15h. 0m. Mars at greatest heliocentric latitude S.
7. 17h. 6m. Jupiter in conjunction with the Moon. (Jupiter 1° 0′ N.).
14. 14h. 16m. Uranus in conjunction with the Moon. (Uranus 4° 35′ N.).
20. 12h. 44m. Mars in conjunction with the Moon. (Mars 0° 12′ N.).
22. 1h. 35m. Sun enters Sign of Cancer. Solstice.
22. 22h. 38m. Saturn in conjunction with the Moon. (Saturn 3° 3′ S.).
25. 9h. 14m. Mercury in conjunction with the Moon. (Mercury 3° 32′ S.).
27. 2h. 38m. Neptune in conjunction with the Moon. (Neptune 5° 28′ S.).
29. 5h. 8m. Venus in conjunction with the Moon. (Venus 3° 40′ S.).
29. 13h. 0m. Mercury in perihelion.

THE TAIL OF HALLEY'S COMET ON MAY 20, 1910.—No. 4496 of the *Astronomische Nachrichten* contains further notes on the question of the direction of the tail of Halley's comet on the evening of May 20, 1910. Prof. Eginitis returns to the discussion, with M. Antoniadi, concerning the appearance of a tail directed *towards* the sun, and suggests that the latter has failed to recognise the exceptional position of the tail, with regard to the earth and sun, at the time, and also its curvature; such conditions would account for the phenomena observed at Athens about which Prof. Eginitis has no doubt and M. Antoniadi contends were impossible.

THE SPECTRUM OF THE RING NEBULA IN LYRA.—Some interesting spectra of the Ring Nebula are published by Mr. Keivin Burns in No. 193 of the Lick Observatory Bulletins. The photographs were taken with a slitless spectroscope attached to the Crossley reflector, in order to determine the spectral type of the central star. Stained and unstained plates were employed, and, in passing, it is interesting to note that a "Cramer Crown" plate stained twenty-one days previously was 50 per cent. faster in the red than a newly stained plate from the same box. The length of the spectrum is only 3·3 mm. between λλ 6560 and 3730, and the width of the image of the Ring is 1·6 mm. in declination.

A comparison of adjacent stellar spectra with the spectrum of the central star showed that while between λλ 6600 and 5800, the latter was only as bright as a 14·2 mag. star of type A or F; at λ 3300 it was as bright as an F-type star of magnitude 12·4. In fact, the spectrum of the central star is relatively stronger in the ultraviolet than that of the bluest of the many Orion-type stars which have been photographed with the same instrument; yet there is not the great difference between the visual and photographic magnitudes of this star that there is generally thought to be. Mr. Burns states that, if isolated, both the central star and the other star within the Ring would be easy objects for moderately large telescopes; he finds their visual magnitudes, by photographic methods, to be 14·1 and 14·7, while their photographic magnitudes are 13·2 and 14·5 respectively. The similarity of the spectrum of the central star to the spectra of central stars, or condensations, in other nebulæ removes any doubt as to its connection with the nebula.

The following radiations were found in the spectrum of the nebula itself:—λλ 3450, 3730, 3870, 3970 (Hϵ), 4100 (Hδ), 4340 (Hγ), 4690, 4860 (Hβ), 4960–5010 (chief nebula line), 5880 (D_3), and 6560 (Hα). Of these, the radiation at λ 3730 is by far the strongest, on the ordinary plate, and is followed by the chief nebula line; the hydrogen lines are relatively faint. The sizes of the rings due to λ 3730 and the hydrogen lines appear to be the same, while those due to the nebula lines λλ 3870 and 500 appear to be smaller. The monochromatic images of the ring show far more detail than a composite image, a fact which suggests that they differ in detail.

PROPER MOTIONS OF STARS BETWEEN +75° AND +80° DECLINATION.—By the comparison of the positions determined at the Kasan Observatory with those given in twenty-two earlier catalogues, Prof. Dubiago has determined the proper motions of some 730 stars, and publishes them in No. 4496 of the *Astronomische Nachrichten*. All these stars occur in the Kasan A.G. zone between declinations +75° and +80°, and the complete results are to appear in No. xv. of the Publications of the Kasan Observatory.

THE GYRO-COMPASS.—A brief description of the gyrocompass, which was exhibited at a recent meeting of the Royal Astronomical Society, appears in the May number of *The Observatory* (No. 435, p. 190). This compass is quite independent of the earth's magnetism, and may therefore be employed in many positions where an ordinary magnetic compass would be useless. It was, in fact, primarily designed for use in polar research, but now proves to be quite unsuitable; it is, however, trustworthy between latitudes 70° N. and S., and is being adopted by several Governments for use in their navies.

The rotating disc is floated on mercury, so that it is free to move in two directions, and the rotation of the earth causes the axis to set itself due north and south. The axis is geared up to an indicator, so that the needle always points N. and S. when the gyro is running. The rotation of the disc is produced by an ingenious electric motor of which the disc forms part, and the inherent tendency to prolonged oscillation is overcome by a most ingenious system of damping by currents of air, the application of the blasts depending upon the amplitude of the oscillation at the moment.

A fuller description of the instrument is given by Mr. G. K. B. Elphinstone in a book, "The Anschütz Gyro-Compass," published by Hugh Rees, Ltd.

ANCIENT OBSERVATORIES IN INDIA.—An illustrated description of the five astronomical observatories erected at the beginning of the eighteenth century by Saway Jay Singh, the Maharaja of Ambhery in Rajputana, is one of the interesting papers in the May number of *L'Astronomie*. M. Ducret, who describes the equipments, states that the observatories were situated at Benares, Muttra, Delhi, Ujjain, and Jaipur, but with the exception of the last named they are in a sad state of ruin. A photograph of the Jaipur Observatory shows huge masonry erections by which the altitudes and azimuths of the celestial bodies could be determined. The installation shows that in 1718–34, when the observatory was erected, the study of astronomy of position was well advanced in India.

THE BRITISH SOLAR ECLIPSE EXPEDITION.

March 30, 1911.

AT the moment of writing we are fifty-five days out from home, and are steaming along steadily in H.M.S. *Encounter* towards the island of Vavau, which we hope to reach on Sunday evening next (April 2). Since leaving Sydney, on March 25, we have experienced a N.E. or head wind all the time, which has somewhat reduced our speed. To-day we are in lat. 25° 20·5′ and long. 174° E., *i.e.* we are well to the north-east of Norfolk Island and to the south of Hunter or Fearn Island.

When boarding the ss. *Otway* at Tilbury on February 3, I was the sole representative of the Solar Physics Observatory's expedition on board, for Father Cortie and Brother McKeon, who joined the ship at the same time, represent the party sent out by the Joint Eclipse Committee. It was not long before I discovered that many cases containing self-recording instruments, books, photographic materials, lantern-slides, &c., for use on the voyage, were not placed in my cabin, and it was only at Port Said that I finally heard by cable that they were all neatly stowed away in No. 2 hatch with hundreds of tons of cargo above them, and therefore inaccessible until Sydney was reached. Fortunately, I had my 5×4 Kodak with me, and supplies of films were easily obtained at Marseilles, Naples and Colombo *en route*.

On the whole, the weather was cold for the time of year on the way out to Australia, and it was only in the doldrums that a high temperature and moisture-laden

atmosphere were felt. I had intended to keep running three self-recording instruments, lent me by Dr. W. N. Shaw, to record pressure, temperature, and the hydrometric state of the atmosphere on the way out and home; but, alas! these were in No. 2 hatch.

We reached Marseilles on February 9, and Mr. F. K. McClean, a volunteer for my party, joined the ship, having travelled overland from London. Unfortunately, we passed Messina at 3 a.m. in the morning, so that the scene of the great earthquake could not be distinguished.

Solar halos were visible daily, and these corroborated the low temperatures we were experiencing. On February 15 Port Said was sighted; it was a beautiful morning, but the air distinctly chilly. The same evening we entered the canal, and took only sixteen hours to get through. In the Gulf of Suez, even with a following wind, it was not hot; in fact, low temperatures were the chief features of the voyage. At Aden my notes state:—"It has been exceptionally cool the whole journey, and especially through the Red Sea."

In the Indian Ocean the temperature began to rise, and the thermometer in my deck cabin, with an electric fan running, registered usually 78°–82° F. at about 11.30 p.m. Colombo was reached on February 25, and although it was somewhat warm on shore, it was nothing to what it was in December, 1897, when I was there on the way out to India for the eclipse of 1898. On the evening of February 26 we had a fine display of lightning. The colour of the flashes was a distinct violet, and each flash, or rather the great majority of them, appeared to quiver, *i.e.* did not seem to be instantaneous, and gave the impression that several flashes passed down the same path in the air. The flashes were, however, too distant to photograph; otherwise I would have recorded their multiple nature by photographing them with a moving camera. The phosphorescence on the water was brilliant that evening (and my cabin temperature 83° F.). I have never been farther south than Colombo before, and so I had been looking forward with considerable interest to reaching the doldrums. I wished to observe and photograph the beautiful cloudscapes which are special to that region.

Monday, February 27, I labelled my cloud day. There were small but superb cumuli sailing over the sky slowly all day. Each cumulus was practically a nimbus, and rain was falling in dense sheets from most of them. The under surface of each cumulus was very flat, and their bottoms seemed to be about 4000–5000 feet high. As we were roughly in latitude 7°, the sun at midday was very high—nearly overhead. Thus the lower portions of the clouds were in deep shadow, and, looking towards the horizon, tier upon tier of their lower portions, due to perspective, made an impressive sight. This day ended with one of the most majestic sunsets I have ever seen. The sun, sinking behind these distant cumuli, rendered them of varied colours. Some were picked out in inky-black with golden edges, while others were tinged with a ruddy hue, with purple for their main mass. Just above the sun, but tremendously high up in the upper reaches of our atmosphere, was a beautiful delicate mass of cirro-cumulus in the form of waves. These exhibited all the colours of the rainbow, and were brilliant in the extreme. A powerful pair of binoculars showed both their structure and colour. Beautiful golden rays also shot up from the sun, making the scene one of perfect beauty. The sight of these rays at sunset are alluded to by sailors as "the sun setting his back stays." After the sun had set, all the clouds became an inky-violet colour, and took all shapes, from French poodles to whales or 4·7 guns. This wonderful sunset was followed next day by an even more perfect sunrise. The sea exhibited that oily look so well depicted by Somerscales—and long rollers were sluggishly passing by making the *Otway* pitch a little. Even the bow way of the *Otway* refused in this oily sea to break, but sped silently away from the ship's side. The horizon at the east, with the distant yet unilluminated cumuli, brought to one's mind spectroheliograph photographs of the sun's limb with the prominences around it, the cloud-forms representing the latter. Gradually the most beautiful dawn began to appear, and the sequence of events during the sunrise seemed to be exactly the reverse of the sunset the night before. In this case the "front stays of the sun" formed a conspicuous feature.

The evenings now were very warm and humid, and my cabin temperatures, at about 11.30 p.m., varied from 82° to 85° F., even with the electric fan running.

FIG. 1.—SS. *Otway* leaving Sydney Harbour for Brisbane. H.M.S. *Encounter* in Harbour (three funnels).

The approach to Australia is not very inspiring, for the coast at Fremantle is very low-lying, both to the north and south. It was here that I first experienced the great kindness of Mr. H. A. Hunt, the Commonwealth meteorologist, during my brief visit to Australia. Knowing that the ship would put in at Fremantle, he arranged for the meteorologist of the Perth district, Mr. Kerr Lewis, to meet me and show me round Perth. But I left the ship to catch the steamer for Perth instead of the train, so we missed each other, and I did not see him until I returned to the *Otway* again in the afternoon. Mr. McClean and I and a Mr. E. C. Anderson, whom I have commandeered as a volunteer observer for our expedition to Vavau, went off and visited the Perth Observatory. It was there we learnt that Mr. Cooke, the director, was away in Melbourne on the Boundary Commission, and we gathered some information about the Australian eclipse party to Vavau also. Mr. Kerr Lewis, the chief assistant at the observatory, very kindly showed us over the observatory, which is in a fine position overlooking the

surrounding country. In recent years the growth of houses in the neighbourhood has been so rapid that its position will soon be spoilt, if it is not already.

The journey from Fremantle to Adelaide was livened by a lecture by Father Cortie on "Comets," and by Mr. McClean on "Flying." To give an idea of the low temperature conditions during this portion of the journey, furs and overcoats were generally worn, and my cabin temperature was about 65° F. When at the Perth Observatory I was informed that the past season in Australia had been phenomenal, the summer having been cold and very wet. This I afterwards found was the case generally for the whole of the southern portion of the continent.

Second Letter.

April 1.

On the morning of March 11 we arrived at Adelaide, and moored alongside the quay. Father Cortie there received a letter from Captain Colomb, the captain of H.M.S. *Encounter*, the ship which had been put on special service to assist both Father Cortie and my party at the eclipse. Captain Colomb informed us that his ship was at present in dry dock at Coccatoo Island at Sydney, and that he would be ready to sail with our party from Sydney on March 25 if that date was convenient. We informed him that this arrangement suited our plans admirably, and at his request we notified him of the amount of our luggage. At Adelaide Mr. Cooke, the Government astronomer of W. Australia, and Mr. Dodwell, the Government astronomer of S. Australia, met us. The Commonwealth Government placed a motor-car at our disposal, but unfortunately our time was so limited that we were unable to make much use of it.

Fig. 2.—Rain Squalls on the Equator.

The journey to Sydney proved most instructive. The region round Ballarat, where we visited my brother, is studded with past and present gold mines. There we were shown over the most up-to-date assaying plant, owned by Mr. Edwards. The following morning a motor run of 100 miles brought us to Bendigo, and we had experience of Australian cross-country roads; in many cases it was a mere track, with no metal at all on it. I was told that I was seeing Australia under very abnormal conditions for that time of year, for instead of scenery of predominating *brown* tints, I was passing through a country as green as any scenery in England. This was due to the exceptional rainfall. At Bendigo we were shown over a battery of 110 stamps. The same evening we left for Melbourne, and the next morning Mr. Hunt, the Commonwealth meteorologist, took us to call on the Hon. King O'Malley, the Minister for Home Affairs. He very kindly welcomed us to Australia, and explained to us the working of his department. Mr. Hunt also showed us over the Meteorological Office of which he is chief. I was in time to see the very efficient system which he has adopted in making his daily forecasts for the whole of Australia. I made the acquaintance of Mr. G. H. Knibbs, the Commonwealth statistician. Next morning (March 15) I visited the Melbourne Observatory. Mr. Baracchi was there full of the question of the Boundary Commission and the coming eclipse, of which he is chief. I renewed my acquaintance with Mr. Baldwin, who some years ago visited the Solar Physics Observatory at South Kensington, and also met Mr. Short, another assistant. I viewed with great interest the great Melbourne reflector, with which I was so familiar from book illustrations. My old friend Dr. Skeats, of the Royal College of Science, but now professor of geology at the Melbourne University, took me off to lunch to meet many of his *confrères*, and then we made a quick tour of the University. This University is growing very rapidly, and arrangements are already in preparation for a considerable increase of the various departments. I had the great pleasure of meeting Mr. Grayson there, who has so successfully achieved the art of ruling very thin lines on glass exceedingly close together—nearer together than those on any gratings yet ruled. He showed me the extremely ingenious methods he was adopting to produce the portions of the mechanism for ruling gratings. The work was of the very highest order, and he accomplishes every portion of it himself. It will be a grand day when we can order large-size ruled gratings from Australia.

On the morning of March 16 Mr. J. Brooks, retired Trigonometrical Survey of New South Wales, and Mr. W. E. Raymond, first assistant, Sydney Observatory, met us at the railway station. Both Mr. Brooks and Mr. Raymond form part of my eclipse party, and both are familiar with eclipse work, as they were with Mr. McClean on his eclipse expeditions to Flint Island and Tasmania. Further, both Mr. McClean and I had been in correspondence with them from England, asking them to make many preparations locally, which they had most satisfactorily carried out. Our total instrumental and camp equipment was increased from 4½ tons to about 6 tons. I had intended to call on Vice-Admiral King Hall and Captain Colomb, of H.M.S. *Encounter*, as soon as possible, but found on my arrival that the former was away in Tasmania and the latter with his ship in dry dock. March 17 was a very busy day. First it was necessary to be down at the wharf to tally off all the eclipse cases as they came out of the *Otway*, though the majority were not going to be moved until late that evening. Then the Lord Mayor of Sydney was going to give us a civic welcome, which was to take place at noon that day. We all assembled at the Mansion House at the time appointed, and were met by Profs. Moors and Pollock, of Sydney University, the Rev. Father Pigot (representing the Eclipse Committee of the Australasian Society for the Advancement of Science), Mr. J. Mangle, the Rev. Dr

Roseby, Dr. Quaife, Mr. Guthrie, Mr. W. E. Raymond, and Mr. Hamlet (representing the British Astronomical Association and the Royal Society).

Prof. Moors, introducing our two parties, remarked that the Australian expedition, which was going to Vavau to observe the eclipse, expected to learn a great deal from us. After Mr. Hamlet's reference to the voyage of Captain Cook in 1770, when he sailed to the South Seas to observe the transit of Venus, and also to the British and Commonwealth expeditions on the present occasion, the Lord Mayor heartily wished all the expeditions success, and instanced the voyages of Sir Ernest Shackleton and Captain Percy Scott as showing what could be gained to science by close study under arduous conditions.

Prof. Pollock expressed the hope that the advent of the present British parties would benefit the scientific workers in Australia and raise and sustain that enthusiasm without which no good work was ever accomplished. Father Cortie replied in an appropriate manner, pointing out that Britishers felt quite at home in Australia, and that such expeditions helped to cement further, if necessary, the friendship between Australia and the Mother Country.

In my reply I laid particular stress on the importance of the occasion for furthering the proposal for a Solar Physics Observatory for Australia. I pointed out the importance of filling up the gap of longitude between Kodaikánal (India) and Mount Wilson Observatory (U.S.A.), and that in Australia the weather conditions were ideal for a large observatory of this kind. I also indicated the important part played by the sun in controlling our terrestrial atmospheric movements, and that a close study of the sun was of first importance to Australians, whose population was so largely composed of those who reaped benefit from the soil. After this pleasing ceremony was over we adjourned to another room to drink the health of the King.

In the afternoon we all went to Coccatoo Island to call on Captain Colomb, the ship being still in dry dock. He greeted us very heartily, and at his request we gave him an account of our programme and requirements.

In the evening we all attended a meeting of the British Astronomical Association, and at its conclusion Mr. McClean, Mr. Anderson, and I went with Mr. Raymond to the observatory to see the show clusters, nebulæ, and double stars of the southern hemisphere.

The following morning was occupied in tallying all the eclipse cases from the *Otway*. These were to be transferred to H.M.S. *Encounter* by steam lighter on Monday, March 20. During the afternoon I boarded the *Encounter* to give Captain Colomb detailed information about the assistance required. I suggested to him the importance of communicating with England as soon as possible after the eclipse in order to inform the home authorities of our results. This he took in hand, and it was arranged that H.M.S. *Encounter* should send a wireless message to H.M.S. *Pioneer* at Auckland, which would be transmitted through to England by cable.

The next day (Sunday, March 19) we all went out by steamer to the beautiful River View Jesuit College, where Father Cortie and Brother McKeon were staying. The rector and the fathers received us in a most hospitable manner. The college is situated away up towards the beautiful harbour of Port Jackson, and is an imposing structure amongst lovely scenery. Since our arrival in Sydney it had been very hot, and the damp atmosphere had made our various duties rather laborious; even the Australians considered it so. The steam to River View was delightful in the extreme, and we were able to gain some idea of the great future such an important port must have. There is very deep water everywhere, and the largest ships can lie alongside any of the innumerable harbours. At River View the very beautiful seismographs, which are in the charge of the distinguished worker Father Pigot, were shown to us. Every detail of these instruments and their functions were carefully pointed out.

The next day (March 20), at an early hour, the steam lighter was alongside the wharf, and Mr. McClean and I went and superintended the placing of the cases in the lighter. Then we steamed away, and with the help of the *Encounter's* crew got all the cases safely stowed away in torpedo flats and other available spots.

This morning I had expected Mr. Hunt to arrive from Melbourne, as I had been requested by the Hon. King O'Malley, the Minister for Home Affairs, through Mr. Hunt, to visit and report on the proposed site for the Solar Physics Observatory near the new Federal Capital site, and Mr. Hunt was to escort me there and back. Mr. Baracci had arranged to proceed to the site from Melbourne, and we were all to meet there. At midday I met Mr. Hunt, and he proposed that we should start the same evening, to which I consented. In the meantime, Mr. Hunt took me to call on Mr. Stephen Mills, the Collector of Customs, who is the successor to Colonel Lockyer (now retired); the latter I met in Melbourne a few days ago. Colonel Lockyer had very kindly given me two letters, one for Father Cortie, which would clear us of any difficulty that might arise in relation to custom duties. These proved very useful, and saved us much anxiety.

W. J. S. Lockyer.

(*To be continued.*)

THE WORK OF THE ROYAL GEOGRAPHICAL SOCIETY.[1]

In looking to the future, it is important to inquire how the society will be able to maintain its reputation and its usefulness in the new conditions of geographical knowledge. It is true that the South Pole is as yet uncaptured, that the map of Arabia is still largely composed of great blank spaces, and that the bend of the Brahmaputra is drawn by guesswork in our atlases. But all these problems will, it is probable, be solved before long, and where then will be the field in which the explorer may hope to win renown by robbing the unknown of its romance? We must sooner or later face the fact that the work by which this society has become best known in the past represents an almost finished chapter in geographical history, and we should sometimes, in preparation for the future, ask ourselves what ought to be our *rôle* when the last leaf in that chapter has actually been turned.

When endeavouring thus to take time by the forelock, we should perhaps in the first place inquire more precisely as to the nature of the change which is now taking place, and as to how soon it is likely to be accomplished. Systematic surveys are, we know, being pressed forward in many parts of the world, of which until recently the maps were produced mainly by the efforts of enthusiastic amateurs, whilst now they are turned out with almost machine-like regularity and precision by Government officials. As to the British Empire, the annual reports of the Colonial Survey Committee show how rapid has been the advance in this direction, and what satisfactory progress has been made, though in certain localities the authorities, in spite of past experience, seem disposed to linger on in a state of comparative topographical ignorance. Outside the British Empire similar changes are taking place, though less rapidly, with the result that when the international map of the world on the scale of 1 : 1,000,000 is completed, as it will be before many years have passed, a large proportion of it will be based on surveys sufficiently accurate to ensure the work holding good for many a century to come, except for the rise of new towns and the alteration in political boundaries. But in spite of all this progress there are likely to remain vast tracts of land, mapped in a fashion, no doubt, but with the details inaccurate and incomplete, where for at least half a century or more from this date the independent traveller will find ample opportunities of adding to the knowledge of the earth we live in. Indeed, for some years to come large areas are likely to exist our knowledge of which can only be increased at the risk of the traveller's life. But although the available topographical information concerning many regions will for long remain very imperfect, yet it is inevitable that the day will come when the whole world will be mapped with fair accuracy, and to that condition of things this society will have to adapt itself.

Nearly all great changes, however, take place gradually, the process of evolution being, as a rule, an advance

[1] Extracts from the address of the president, Major Leonard Darwin, at the anniversary meeting of the Royal Geographical Society, May 22.

made by a great number of small steps; and no sudden geographical revolution need be feared. To move with the times ought not to be very difficult, therefore, and to do so it is mainly necessary to look to the immediate future, or to take "short views of things," to use the words of that wise man Sydney Smith. If this policy be steadily pursued, there need be no cause for alarm for many years to come, at all events; for, as already suggested, plenty of geographical work yet remains to be done. We ought no doubt, in view of the changing conditions, to direct our efforts with more persistence than heretofore in the direction of encouraging travellers to make systematic and detailed examinations of comparatively small areas, and not merely to cover long distances with the result of doing little more than confirm the impressions of previous explorers. Their surveys should be as good as is possible in the circumstances, and the information they collect should be extensive, varied, systematic, and recorded with reference to the needs of the students of science and history, as well as of the man of commerce. In short, the traveller of the future ought to be a trained topographer, or to have thoroughly prepared himself in advance for some definite class of investigation.

As regards internal administration, the aim must be to make the society's house a place where accurate information can readily be obtained concerning all countries, including our own, the information thus supplied being all that could be described as geographical within the most elastic meaning of the word. The acquisition of suitable maps and books should, indeed, in future only be limited by financial necessity, whilst the collection of geographical photographs should be well maintained. No pains should be spared to make our systems of indexes as perfect as possible, a subject to which, as a fact, considerable attention has recently been paid; and with such aids the staff should be in a position to give every assistance to all students wishing to utilise the vast stores of information which the premises should contain. In short, we shall want more maps, more books, more photographs, and a more convenient house to hold both them and the steadily accumulating objects of interest which we own; and if the society continues to grow in usefulness on the lines suggested, we must look forward to the possibility of a material increase being needed in the number of the staff. Moreover, our means of keeping touch with foreign countries should be considered from time to time, to see if they are not capable of improvement. For example, as a single possible suggestion, might it not be worth considering whether British consuls, whilst actually serving abroad, should not be allowed to join our ranks with some special advantages as regards fees? Then, again, partly with the same object of facilitating the supply of information to our fellows, partly with the view of making our collections more generally useful, and partly in order to disarm the criticism made against us of wishing to poach on the preserves of other sciences, it might perhaps be well to allow the fellows of certain other learned societies to use our libraries with the same freedom with which they can now consult the maps in our map room.

As to the work of exploration and investigation for which we are not directly responsible, this should, as heretofore, continue to receive our warmest encouragement and our help when possible.

One other function which this society may always usefully perform, and one which has thus far been too much neglected. Science is cosmopolitan, and certainly the records of this society's proceedings during recent years, where the names of Sven Hedin, Peary, Charcôt, and many other distinguished foreign explorers so prominently appear, prove that this aspect of our duties is not now being overlooked. It is not, however, as it seems to me, in the least inconsistent with a belief in our world-wide obligations to hold that the work done by our fellow-countrymen has an especial claim on our attention, and that one of the aims of a national geographical society should be to keep alive the knowledge of the great deeds of British explorers in the past. Is it not probable that the history of Australia and New Zealand would have taken a very different turn if the work actually done by Captain Cook had been forestalled by some explorer owing nothing to these isles? And yet to that great man no fitting monument has yet been erected. As to Africa, its map should have the names of our fellow-countrymen written all over it if intended to indicate the historical development of that continent—a development due in large measure to British exploration, the history of which we should never allow to die. In the case of thousands of adventurers who set forth to America and elsewhere from these islands in times gone by, and to whose exertions is largely due the fact that English is now the most widely known language on the face of the earth, and that these islands hold in relation to their size an absolutely unique place in the history of the world, it is true that of these men we do not even know their names, though the effect of their exertions yet surrounds us on every side. It is to be hoped, therefore, that there will always exist in this land a body of men banded together with the object, amongst others, of making more widely known what was done by British explorers in the past, and of honouring the heroic spirit of these unnamed thousands which drove them forth to face untold dangers, and thus to help to build that Empire of which we are so proud.

ORGANISATION AND PROGRESS IN ECONOMIC BIOLOGY.

DURING the past decade economic biology has slowly but surely taken a definite place in our system of sciences in this country, and although at present but a sturdy infant, it would seem that it is destined to play no mean part in stimulating research and experimentation in the near future.

We have, fortunately, outgrown the prejudice that has for many years clung to practical science, and on all sides we can see investigations taking place of deep and far-reaching scientific interest, but at the same time fraught with great import to man and his multifarious activities.

Once men begin to think and work along certain definite lines, it is not unnatural that they should seek to associate together, in order to discuss their methods of work, and the latest results obtained by their investigations. Without such association much unnecessary duplication of work occurs, and the lack of organisation retards otherwise legitimate progress.

The foundation of the Association of Economic Biologists in November, 1904, was the outward expression of a feeling such as this that had long been simmering in the minds of economic biologists in the British Isles, and on the occasion of the tenth general meeting, which has recently been held at the University of Birmingham, where the first meeting took place, it seems not unnatural that we should pause and reflect upon the organisation and progress of this special branch of biological science.

During the life of the above association, meetings have been held at the universities of Birmingham, Liverpool, Cambridge, Edinburgh, Oxford, and Manchester, and one each at the Imperial Institute and University College, London. In looking at the list of papers read at these meetings, one cannot fail to be struck at the large amount of original work that has been carried out by the members, much of which has been published and adequately illustrated. The problems discussed relate to almost every subject wherein the economic biologist can aid or assist the physician, veterinarian, agriculturist, horticulturist, stock breeder, fruit grower, forester, fisherman, manufacturer, &c. Since 1904 the members of this association have contributed in no small degree to the general advance that has been made in this particular science.

With progress and increased interest the workers also increase, and it is significant that at the last two meetings questions relating to organisation have figured prominently in the programmes. Few will forget Prof. Hickson's admirable address delivered last year at Manchester, on the place of economic zoology in a modern university, or the discussion that followed, both clearly indicating how fully it was realised that a sound scientific training was the best preparation for future specialisation.

In a more restricted sense, Mr. H. Maxwell Lefroy dealt with the training of economic entomologists at the last meeting. Mr. Lefroy has had a long and unique experience of the kind of men that are required in our colonies, but so far he has failed in his efforts to obtain such from

this country. From his address we gather that he would dissociate entirely the training in entomology from the general zoological training, doing it as a post-graduate course. The trend of the course, he pointed out, must not be that of the comparative anatomist, the evolutionist, the systematist, or the histologist. The difficulty in making economic zoologists in England, he thought, would be the preponderance of the academic view and the total absence of the economic view based on experience. English universities have a very long way to go before they can turn out entomologists of the practical stamp that America does.

Referring to the lack of knowledge of entomology of the medical men who apply themselves to entomological problems, he described it as very painful, but in England there are so few places where medical men can obtain their training, and even then it seems to lack much. The kind of training in our universities is too academic for men who are required to solve problems requiring practical solutions.

We are on the threshold of greater things, and whatever problem comes one must put one's hand on. Only so is the practical entomologist going to convince an unlearned public and sceptical governments that there is anything at all in it, and we are, in England certainly, beginners who must look to the future. England should be the source at least of the entomologists of her Empire, but she is not, and unless radical changes take place in the atmosphere of her teachers, she will not be. The training will have to be that of practical field entomologists if the demand has to be met from England, and the last thing it wants is the academic zoological training of the average English university.

A perhaps more important subject to economic biologists generally was Mr. H. Maxwell Lefroy's address on the standardisation of economic nomenclature. The almost hopeless muddle that at present reigns in the nomenclature in the literature bearing on economic biology is little short of appalling.

Mr. Lefroy proposes to meet this difficulty by having a standard catalogue of the important species with the name most in use in biological literature definitely decided on, so that the further changes in nomenclature need not affect the economic biologist. The guiding principles would be that it should be independent or unaffected by the rules of priority. It should be based on the name used in important biological literature. Genera in which there is a close uniformity of habit and life-history, or which form a distinct class of pest, shall, for this purpose, be retained whole and not subdivided, *e.g.* Lecanium, Dactylopius, Agrotis, Gryllotalpa. To make existing and future biological literature accessible by adopting and making permanent the name under which it was written, and not to perpetuate inviolate the author of a name or description in the systematic literature. Writing recently on this subject, Mr. Lefroy stated, "In this matter, teachers and practical entomologists alone are concerned; to the systematic entomologist, the mazes of synonym and priority are (apparently) the breath of life, and the pastime might be a quite harmless one; . . . but to practical men who wish to check the growing spread of insects from country to country, who wish to cooperate to deal with big problems, who see in agricultural education the chief solution of these big problems, the question is one of vital importance. I think all economic entomologists will agree that we are immensely adding to the difficulties of our work, if it is to be anything more than parochial, either by modifying our nomenclature in accordance with the priority discoveries of systematists or by arbitrarily using the nomenclature we think most suitable. It is impossible for an isolated worker in a far country to do more than offer suggestions; I feel assured it will be for the permanent ultimate good of our science if we can overcome this growing monster, and I think the Association of Economic Biologists might fitly take up the subject."

As the outcome of Mr. Lefroy's suggestion it was decided to form a committee to consider and report upon the matter. The committee appointed were Richard S. Bagnall, Prof. Geo. H. Carpenter, H. Maxwell Lefroy, Dr. R. Stewart MacDougall, Robert Newstead, and Walter E. Collinge (hon. sec.).

Such a scheme will greatly facilitate investigation and the reference to work done, and this desire to place matters upon a sound basis is perhaps one of the best auguries for the future prosperity of the association.

A further very interesting discussion was initiated by Dr. J. H. Priestley on the systematic recording of diseases of economic plants. The Biological Committee of the Agricultural Education Association have for some time past given consideration to the question of establishing at a convenient centre a record, as complete as possible, of the various fungus, insect, and other diseases of economic importance, reported in the British Isles from time to time. The main object of such a record would be to aid the scientific investigator who wished to get into touch as quickly as possible with the scattered literature and notes dealing with the distribution of, and other questions relating to, some disease or pest of which he was making a particular study. It had been decided to approach other bodies likely to be interested with a view to cooperation. It was decided to give the scheme approval and support.

All these activities indicate the growing importance of the subject, the possibilities of which we have yet but dimly realised; the multifarious lines of research are vast and the field is an ever widening one, and the need for work and workers pressing. That the workers of this country will bear their share in elucidating some of the hidden mysteries, and directing their application on the problems of our everyday life, is greatly to be hoped.

W. E. C.

ECOLOGICAL STUDIES.

A NOTE by Dr. C. C. Hosseus on the flora of Wang Djao, a station on the Meping River in middle Siam, appears in Engler's *Botanische Jahrbücher* (vol. xlv., part iii.). Trees of *Dipterocarpus laevis* and other species clothed with epiphytes, especially orchids, are prominent along the river banks. On the savannah lands in the vicinity *Cassia siamea* is the dominant tree, while *Andropogon brevifolius*, species of Scitamineæ, and *Hibiscus Abelmoschus* are conspicuous amongst the ground vegetation.

In the Bulletin of the Illinois State Laboratory of Natural History (vol. ix., art. 3), Dr. H. A. Gleason presents an instructive ecological study of the vegetation of the inland sand deposits of Illinois. He distinguishes prairie, blowout, swamp, and forest formations. The prairie formation consists largely of bunch grass associations, in which *Koeleria argentea*, *Leptoloma cognatum*, *Panicum pseudopubescens*, and *Andropogon scoparius* are dominant species, either alone or in combination. On the patches between the grass clumps there grow various perennials of the type of *Aster linariifolius*, or *Callirhoe triangulata*, some annuals, and *Selaginella rupestris*, which spreads in circular rings. The formation and different aspects of the sand dune are described. The most efficient dune-formers are *Panicum virgatum*, which possesses long tough roots and tufted stems densely covered with persistent leaves, and a local variety of *Rhus canadensis*, which continually grows above the sand that collects around its dense tangle of stems.

A phytogeographical sketch of the Andes in the south-east of Bolivia, communicated by Mr. K. Fiebrig to Engler's *Botanische Jahrbücher* (vol. xlv., part i.), provides a good biological account of the remarkable modifications developed on the wind-swept high plateaux, the Punas, at an altitude of 12,000 feet. Cushion plants of a much branched, closely compacted character are displayed by *Azorella madreporica* and *Pycnophyllum Pilgerianum*, while a less extreme type is developed by many of the Compositæ, an Ephedra, and the globular cacti. Acaulescent long-rooted plants are exemplified by species of Astragalus, a new species of Alyssum, and *Dalea callianthes*. The numerous dwarf shrubs include many species of Compositæ, a Fabiana (Solanaceæ), and the thorny rosaceous plant, *Tetraglochin strictum*. Several bulbous plants occur, notably an Alstrœmeria and a grass-like Sisyrinchium, and an evil grass, *Festuca orthophylla*, covers extensive patches with porcupine-like leaves. Other formations described are the Alpine, the valleys, and the lowland forests.

SOME RECENT WORKS ON AQUATIC ANIMALS.[1]

(1) DR. PASCHER'S monograph contains the first instalment of observations in progress on the biology of this "Grossteich"—a lake situated about 100 km. north of Prague. The present memoir, on the Chrysomonads (except the purely planktonic forms), deals with their classification (two new genera and eight new species being described), structure, motion, division, and encystment. The occurrence of contractile vacuoles in Microglena and of siliceous needles, as long as the cell, projecting from the surface of Mallomonas, are among the more noteworthy features referred to.

(2) The genus Ceratium is so common a constituent of the fauna of many lakes and seas that an account of its species, and the help offered in their more accurate identification, will be welcome to workers on plankton. A short account is given of the morphology and fission of *C. tripos*. The genus is divided into four sub-genera, the armature and relationships of which are examined. It is concluded that the genus probably arose in temperate waters, and spread thence into warmer and colder regions. There are no known "bipolar" species. *C. cornutum*, one of the three widely distributed fresh-water species, seems to be the oldest living species and to stand nearest to the hypothetical ancestor of the genus. The structural plan of the fresh-water species suggests that they are primitive, and that by migrations into the sea the marine forms have arisen, and subsequently attained their great differentiation. The author regards the heteromorphic chains discovered by Lohmann, in which the individuals at the two

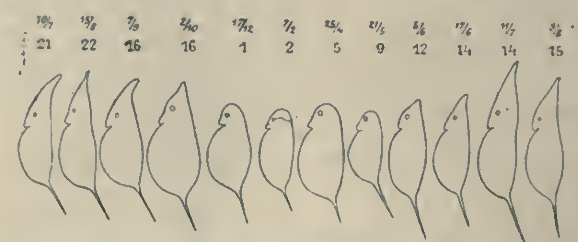


FIG. 1.—*Hyalodaphnia cucullata*, from Fursee, Denmark. Note the elongation of the cephalic shield in the individuals taken in the summer. The upper row of figures indicates the day and the month of capture of specimens, the lower row the temperature of the water (in degrees centigrade).

ends of the chain present more or less the characters of two distinct species, not as normal, but as due to retrogressive phenomena; possibly the reduced salinity of the Baltic, in which they were observed, is responsible for their formation.

(3) Dr. Wesenberg-Lund gives an account of some of the more recent work on fresh-water organisms, especially of his own observations on the planktonic fauna of the Danish lakes. He directs special attention to the variations in temperature, specific gravity, and viscosity of the waters of lakes at different periods of the year, and points out that, while the change in the specific gravity due to temperature variation is insignificant, the viscosity alters very considerably, being, in fact, only half as much at 25° C. as at 0° C. He concludes that, correlated with this latter factor, are certain morphological changes. For instance, examples of the Daphnid Hyalodaphnia, taken in summer, exhibit great elongation of the cephalic shield, which has the effect of so shifting the centre of gravity that, while the animal previously swam almost perpendicularly, it now moves almost horizontally, and its resistance to falling is thus very considerably increased. In the nearly related Bosmina the body is, in summer, higher than long, but in winter longer than high; the antennæ are twice as long in summer as in winter. It is pointed out that when the extent of these "temporal" variations is fully realised there will, no doubt, be a great reduction in the number of recognised species. A further example of modification is given—the rotifer *Asplanchna priodonta*, the body of which is in winter subspherical, but in summer is about five times as long as broad, and approximately cylindrical, so that if the horizontal position be assumed in swimming, the animal presents a greater resistance to sinking. Increase in the length and number of processes (*e.g.* Ceratium) or an increase in the surface of organisms is noticeable in summer, correlated with the increased flotation required.

(4) Dr. Weigold's account of the Lyncodaphnids and Chydorids of Saxony contains much information regarding the specific characters and biology of these Crustacea, details being given of the number of moults, the length of life observed, locomotion, relations of the sexes, variation

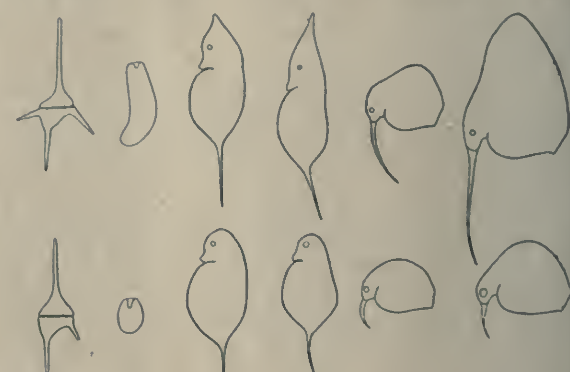


FIG. 2.—*Ceratium hirundinella, Asplanchna priodonta, Daphnia hyalina, Hyalodaphnia cucullata* and *Bosmina coregoni* (two races). Upper row; summer forms with increased power of floating; lower row, winter forms.

in form and numbers. The introduction of Chydorids to isolated waters is brought about almost exclusively by birds. The author has carefully worked out the breeding seasons, and shows that, in the plains of central Europe, the Chydorids have two sexual periods, sometimes almost confluent, but exhibiting maxima in July and October; in more northerly regions and in mountain waters the maxima approach one another, and finally blend into a single breeding period in August-September.

(5) The work described in the fifth memoir was undertaken in order to decide, by renewed observations and experiments, whether the conclusions reached by Weismann or those of some of his critics are to be accepted. The main results go to show that *Daphnia magna* passes, during the course of a year, through several phases, but the various generations and broods are not so sharply circumscribed, in regard to the mode of their egg-formation, as Weismann believed. The author states his views of the sequence of phases thus:—resting egg—strong tendency to parthenogenesis—waning of parthenogenesis and increased tendency to sexual reproduction—strong tendency to sexual reproduction—resting egg. The parthenogenetic and resting eggs, the genesis of which is traced, differ from one another, not only in number and in nature of yolk and shell, but also in mode of formation; each of the former arises from a group of four cells, one of which becomes the egg, while the other three are

[1] (1) Monographien und Abhandlungen zur Internationalen Revue de gesamten Hydrobiologie und Hydrographie. Band 1, Heft 1.—"De Grossteich bei Hirschberg in Nord-Böhmen. I. Chrysomonaden aus dem Hirschberger Grossteiche. Untersuchungen über die Flora des Hirschberger Grossteiches. 1. Teil, von Dr. A Pascher. Pp. 66+Taf. iii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1910). Price 10 marks.
(2) Die Ceratien. Eine kurze Monographie der Gattung Ceratium Schrank, von E. Jörgensen. Pp. iv+124+Ta. x. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 11 marks
(3) Grundzüge der Biologie und Geographie des Süsswasserplanktons nebst Bemerkungen über Hauptprobleme zukünftiger limnologischer Forschungen, von Dr. Wesenberg-Lund. Pp. 44. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 1.50 marks.
(4) Biologische Studien an Lyncodaphniden und Chydoriden, von Dr. H. Weigold. Pp. 118+Taf. x-xii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 5 marks.
(5) Studien und Experimente über die Eibildung und den Generationzyklus von Daphnia magna, von U. v. Scharfenberg Pp. 42+Taf. viii+ix (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911.) Price 2 marks.
(6) Natural History of the Larvæ of Donacinæ. By Dr A. G Böving. Pp. 108+plates viii. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1911. Price 5 marks.

nurse-cells; the resting egg arises from a modified group of four cells, which absorbs numerous other four-celled groups. The author confirms Weismann's statements that the origin of resting eggs is not connected with any influence of the male, that these eggs do not enter the brood pouch, but if not fertilised degenerate in the ovary, that the carapace of Daphnia changes into an ephippium only if the ovary is forming resting eggs, and that these eggs invariably give rise to females.

(6) The Donaciinæ, a sub-family of the Chrysomelidæ (leaf-beetles), are of special interest on account of certain peculiar features in the habitat and mode of life of the larvæ, which are fully described and illustrated in Dr. Böving's memoir, which also contains an exhaustive account of the larval anatomy. The author concludes that the features hitherto utilised to differentiate the larvæ of Hæmonia and Donacia are unserviceable; it has, in fact, not been possible to find real generic distinctions between the larvæ, although the adults present well-marked differences. Conversely, though the adults of Donacia and Plateumaris have been found to exhibit only small differences, from which it might have been expected that the larvæ would be difficult to distinguish, it is shown that the larvæ of Plateumaris, here described for the first time, are dissimilar from those of all other Donaciinæ. The larvæ gnaw the roots of certain aquatic plants (Potamogeton, Sparganum, Carex, &c.), and while doing so arrange the head and prothorax so that the latter forms with the plant a water-tight compartment in which the head can work undisturbed by, and the food be kept from admixture with, water and dirt. The mandibles of the larva have a cutting, and not a crushing, edge; they cannot be used for grinding, and, in fact, serve only to make an entry into the plant tissue, the sap of which then exudes and is received by the laciniæ of the maxillæ and passed backwards into the gut. The larvæ seem to feed exclusively on the sap; an examination of the gut contents, which consist of a homogeneous yellow fluid, shows that cell-fragments are not present. The external features of the head, the mouth parts, the muscles, and the mechanism of feeding are considered in great detail.

Aquatic insects have adopted various devices for obtaining a sufficient supply of air; the larvæ of the Donaciinæ have chosen a very remarkable one, namely, to tap the reservoirs of air in the intercellular spaces of the submerged parts of plants. At the posterior end of the abdomen is the "abdominal organ," which the author shows to be a bifore spiracle. The terminal hook of this organ is plunged into the vegetable tissue, air passes from the latter into the organ, and apparently through thin membranes into an atrium, which leads into the main trachea. The spiracular slit in the abdominal organ serves for expiration.

The making of the cocoon is described at length. The outer envelope is formed by a secretion of the whole body, and is lined with a substance produced in four large œsophageal glands; the larva gnaws one or two holes through the bottom of the finished cocoon so as to make connection with the air spaces of the root to which it is attached; air is thus secured for the pupal stage. The author gives a list of the food plants of the different species of larvæ of this family found in Denmark, and accounts of the gnawings, the sizes of the larvæ at different periods, the length of larval life, hibernation, the flying period of the adults, the eggs, and the post-embryonic development. The memoir forms a substantial addition to our knowledge of the anatomy, biology, and development of these interesting larvæ.

J. H. A.

PHYSICAL ANTHROPOLOGY OF AUSTRALASIAN RACES.

IN the Proceedings of the Royal Society of Edinburgh for the present session (1910–11) appears a series of four papers devoted to the physical anthropology of the races of Australasia. The papers are by three authors, two of them human anatomists, Prof. R. J. Berry and Dr. A. W. W. Robertson, the third a mathematician, Mr. K. Stuart Cross. The authors seek to fix the position of the Tasmanian and Australian natives amongst present and past races of mankind by applying biometrical methods to certain measurements of the skull.

The most valuable paper of the series is that by Dr. Robertson, where he gives the data obtained from measurements of 100 Australian crania. By applying Prof. Karl Pearson's test for purity of race, Dr. Robertson finds the native Australians are "pure" when the measurements of the width of the cranium is considered, but "impure" when the lengths are investigated. It will be seen that Dr. Robertson's results are somewhat equivocal, and may be quoted in support of either the unity or duality of the Australian race. Similar methods applied to the Tasmanian race show a much higher degree of homogeneity or purity. The difference in purity between the Australian and Tasmanian races may be explained by the fact that one is spread over a large continent, while the other is confined to a small island.

An attempt is also made by the authors to fix the position of the much-discussed Tasmanian race in the scale of human evolution. The result will somewhat surprise those who have sought to establish racial relationships on an analysis and comparison of mere anatomical characters, for by the methods here employed the Dschagga negro comes out as the advance guard of the human race, well in front of the European, while the native Tasmanian gains a good place, being sandwiched between two ancient Europeans—the man of Brünn and the Cro-magnon race.

From an anatomical point of view the results are surprising, for it would be hard to find greater cranial contrasts than those between the Tasmanian and Cro-magnon on one hand, and the Tasmanian and Brünn on the other. There can be no doubt, however, as to the high value of the new data with which these papers supply anthropologists.

THE PRODUCTION AND IDENTIFICATION OF ARTIFICIAL GEMS.[1]

I PROPOSE to limit the term "artificial" to such productions as possess the same chemical composition and physical constants as the natural stones, differing from them only in minute details consequent upon their being produced in the laboratory instead of being dug out of the earth, all other makeshifts being properly described as "imitations."

The scientific examination and identification of gems is a matter of the greatest interest, but it would take far too much time to discuss it in detail; and it is quite unnecessary to do so, because it has already been brought before the society most exhaustively by our chairman, Dr. Miers.[2] I propose, therefore, merely to remind you of the main points.

In order to bring this matter up to date, however, I must refer briefly to one or two particulars in which advance has been made since the time of these lectures.

The most important properties of a precious stone are those depending upon its refractive powers. Until recently, the accurate determination of the refractive index of a stone was a matter involving the use of complicated and expensive instruments, and a matter for the skilled mineralogist rather than the practical jeweller. It is true that at the time Dr. Miers published his lectures there existed an instrument known as the reflectometer, but the determination of the refractive index with this was a matter of some difficulty even in skilled hands, and its value for commercial purposes was very small. Since that time, however, thanks to the ingenuity of Dr. Herbert Smith, this instrument has been improved out of all recognition, and in its place we have the Herbert Smith refractometer (Fig. 1), by means of which anyone of normal common sense can determine the refractive index of a stone in a few seconds without even removing it from its setting, and which, with a little practice, will also enable one to determine with similar ease the amount and kind of double refraction and the degree of dispersion.

Taking the properties of precious stones as a whole, the great point about them is the remarkable combination of qualities; it is not so much that they have optical

[1] Abstract of a paper read before the Royal Society of Arts on April 26, 1911, by Noel Heaton.
[2] Cantor Lectures on Precious Stones, April, 1896.

properties which make them extraordinarily beautiful, or that they have remarkable hardness and durability, but they have *both*, and it is the impossibility of reproducing this combination in any other material that renders the detection of imitations a matter of ease in the hands of anyone familiar with the facts.

The most important point to remember about paste is its lack of durability; it is not only too soft to stand much wear, but its composition is so unstable that it rapidly deteriorates and loses its brilliancy on exposure. You will see, therefore, that although there is a certain legitimate scope for such paste imitations, they are very unsatisfactory substitutes for the genuine article. This being the case, as scientific knowledge has advanced, attention has been more and more concentrated on the problem of producing by artificial means the actual minerals found in nature, and thus obtaining what I have defined as artificial in contradistinction to imitation jewels, having both the beauty and durability of the natural article without the objectional concomitant of enormous cost.

The first point to be considered in attacking this problem is the composition of the stone, as it is obvious that, other things being equal, the possibilities of success are greater with a stone of simple than one of comparatively complicated composition. The economic aspect has also to be considered—it is not much use devoting time and ingenuity to the production of an artificial stone when the natural one is so common that the cost of the two would be practically identical.

Commercially, we are as far from being able to produce artificial diamonds as in the days of the alchemists. It is,

FIG. 1.—The Herbert Smith Refractometer.

perhaps, a bold thing to say that no such thing as an artificial diamond will ever be placed on the market, but one can safely assert that, so far as our knowledge stands at present, it is impracticable. In saying this, I am quite aware that statements as to the commercial production of synthetic diamonds being an accomplished fact have quite recently appeared broadcast in the public Press, but those who are responsible for such statements are (shall we say?) under a misapprehension as to the meaning generally conveyed by the term "synthetic," and are unable to follow the distinction I have drawn between an artificial gem and an imitation.

The chief problem to be faced is that of attaining the necessary temperature, and it is not surprising that crystalline alumina was produced as a scientific curiosity so far back as the commencement of the nineteenth century. It is at this time that we first begin to hear of the oxy-hydrogen blow-pipe (or the gas blow-pipe, as it was then called). The process of producing reconstructed rubies by means of the oxy-hydrogen blow-pipe is, roughly, as follows:—The residue from cutting rubies and small worthless stones is broken into coarse sand, a small quantity of which is placed on the centre of a disc of platinum; this is then carefully brought to the fusion point, care being taken at this stage not to raise the temperature to such an extent as to melt the platinum support. So soon as this mass is fused it serves to protect the platinum, and the reconstructed ruby can be built up on it by adding the fragments of ruby one at a time by means of small platinum forceps. These pieces have to be dropped on with great care in order to secure incorporation with the mass and prevent, so far as possible, the formation of air bubbles. It will be readily understood that this process is a tedious and laborious one, and, in fact, the formation of masses of sufficient size to yield large stones on cutting is a matter of such difficulty that the cost of production is very high.

Just about seven years ago, however, Verneuil[1] overcame this restriction when he hit on the extremely ingenious idea of introducing the raw material through the blow-pipe, and thus placing it on the support automatically. The blow-pipe is arranged vertically over a small insulated chamber containing the support on which the mass is to be built up. The oxygen tube communicates at its upper extremity with a funnel-shaped hopper, in which is suspended a small sieve filled with the raw material, which is rhythmically shaken by means of a small hammer actuated by an electromagnet or cam. Each time the hammer taps the support of the sieve, causing it to vibrate, a small quantity of the powder falls through into the tube below, and, carried along by the gas, passes out at its lower extremity into the zone of flame, where it is immediately raised to the fusion point, and falls as a melted globule on to the support below.

This support is arranged with a screw adjustment, so that as the mass of corundum is gradually built up by the constant addition of fresh globules the surface can be kept at a constant level, and the portion already formed removed from the zone of heating so as to allow it to stiffen. When the apparatus is first started the blow-pipe is adjusted so as to give a comparatively cool flame, and the powder is admitted slowly. By this means a small "stalk" is formed, which insulates the mass from the support and prevents the fusion of the latter. When this has been formed, the full pressure of the blow-pipe is put on, and the rate of admission increased, with the consequent formation of a "boule," as it is termed, having the shape of a pear, as illustrated in Fig. 2.

FIG. 2.—"Boules" of Artificial Corundum.

With this apparatus a boule weighing some twenty to thirty carats, and capable of yielding two cut stones of about six carats each, can be prepared in about half an hour almost automatically, a single operator being able to control several machines.

The "synthetic" corundum produced in this way, if pure ammonium alum is used, is, of course, colourless, and can be used as artificial white sapphire. If a small proportion of chrome alum is added, the resulting stones are rubies, and other colours may be produced in the same way. For a long time all attempts to reproduce the fine blue of the sapphire failed. A year or so ago, however, the problem of producing synthetic sapphire was finally solved by the use of titanium oxide, a very unexpected result considering the chemical position of this element. The artificial production of the corundum gem-stone may be considered to be completely solved, and cut stones can now be obtained in every variety of colour, from pure

[1] "Mémoire sur la reproduction artificielle du rubis par fusion," M. A. Verneuil, *Annales de Chimie et de Physique*, September, 1904.

white to ruby and sapphire, at prices ranging from four to ten shillings a carat, according to colour, quality, and size.

Whatever may be their economic importance, a very much debated question, there can be no doubt as to the scientific interest of this group of artificial gems. In the first place, it is a matter of some interest that a mass of fused material formed in this way should not only be crystalline, but possess all the characteristics of a single crystal. Crystallographers are agreed that each boule is a single crystalline individual, with the axis roughly perpendicular to the plane of formation—that is to say, running from the point of attachment of the pedestal to the top of the mass.

Then there is the matter of coloration. One would like very much to know what is the state of combination of the chromium in a ruby, and whether the colour is produced by chromium aluminate in solution or metallic chromium in molecular suspension.

A point of more practical interest is the fact that although the artificial corundum is a true crystal, it possesses the shape and formation of a congealed liquid or glass. The practical interest of this lies in the fact that it affords the only means of distinction between this artificial corundum and the naturally formed gem-stone. Being of exactly the same composition and crystalline structure as the natural mineral, it cannot be identified by any of the physical tests I briefly referred to above. For all practical purposes, the artificial ruby *is a ruby*, and one can only deny that it is a "genuine ruby" if this word is held to connote essentially a product found in the earth and not made by man.

FIG. 3.—Section of Natural Ruby, ×100.

And yet, owing to the curious anomaly of its structure, the artificial product can almost invariably be distinguished from the natural with the greatest ease. In the naturally formed stone any foreign matter which may be present is coerced into following the lines of growth of the crystal, and more particularly bubbles of gas which may be present in the liquid are distorted from their natural shape so as to accord with this symmetrical growth. It is the great exception to find a natural ruby entirely free from such inclusions, which generally form irregular cavities with a decided tendency to geometrical shape.

In the great majority of cases examination of the cut stone with a lens is sufficient to decide the artificial process of formation, but in doubtful cases a more minute examination may be made by placing the stone in a little cell filled with highly refracting liquid, in order to secure regular illumination, and examining it under the microscope by transmitted light, when the minutest trace of structure can be detected. In the case of an absolutely flawless stone it would be impossible to decide whether it were natural or artificial, but such stones are so rare that this case is almost theoretical.

Reconstructed emeralds have been made by the Verneuil process, but these are, of course, amorphous, and do not possess the double refraction and other properties consequent upon the crystalline structure of the natural stone. The problem of producing this stone artificially has not as yet been solved.

The opal ranks with the diamond in resisting attempts at artificial production, and is even superior to it in that it cannot be really successfully imitated.

The peculiar lustre of the pearl, like the colour of the opal, is due rather to its structure than its composition. It is formed in the oyster by the deposition of successive layers of calcium carbonate round some central object, and consists of an innumerable number of thin overlapping laminæ of the crystalline variety of this substance known as aragonite. These layers being semi-transparent, the light falling on the surface is partially reflected from the surface and partially transmitted into the stone, where it suffers reflection from the surface of lower layers.

Perhaps the well-known Japanese pearl may be correctly described as artificial pearl, although the oyster has a great deal to do with it.

Such pearls are formed by introducing a mother-of-pearl shape between the shell and mantle of the oyster, and then leaving the oyster alone for a time to allow it to convert this into a pearl by the deposition of several layers of nacre. The mass is then removed from the shell and converted into the semblance of a true pearl by supplying a back of mother-of-pearl. Such pearls, however, never have the fine orient of those produced under normal conditions, and they can readily be detected by examining the back, when the lustreless mother-of-pearl and the line of junction can be detected.

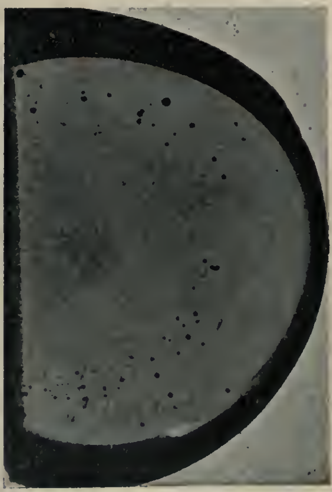


FIG. 4.—Section of Artificial Ruby, ×10.

Nobody has any right to supply anyone with paste under the name of artificial (or synthetic, or scientific, if these names are preferred) gem. I think that the distinction between the two should be clearly recognised, and that it should not be permitted to use the term artificial indiscriminately. At present this is being widely practised; every day one sees offered for sale "rubies, emeralds, sapphires, and pearls artificially produced, and having all the properties of the natural stone." Now, as I have indicated, such a thing as an artificial emerald answering this description is unknown, and, as a matter of fact, the stones supplied under this title are, as a rule, nothing more or less than paste imitations, the public being deliberately led to believe otherwise. There is in this case, as I have indicated, a real practical difference between the two articles, not merely a question of opinion.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—In the faculty of medicine an important change in the organisation of clinical teaching is being made. Hitherto this branch of teaching has been quite outside the control of the University. A clinical board appointed by the staffs of the Queen's and General Hospitals has directed the teaching and collected and administered the fees of students. In future the clinical board is to consist of nine members, of whom five will be appointed by the University and four by the two hospitals. The board will arrange all details of clinical teaching, and will nominate to the council of the University persons in the hospitals to act as clinical teachers, who will become members of the University staff. The fees for this teaching will be paid to and administered by the University. In consequence of the new arrangement, medical studies will be recognised by the Board of Education as a "technical" subject, in

aid of which a grant of money may be made—a privilege which could not be allowed so long as a part of the medical curriculum lay outside the control of the University.

CAMBRIDGE.—Mr. A. E. Shipley, F.R.S., Master of Christ's College, and Mr. P. V. Bevan, of Trinity College, have been approved by the general board of studies for the degree of Doctor in Science.

The Rede lecture will be delivered on Thursday, June 8, at 10.30 a.m., in the lecture room of the Botany School by the Hon. C. A. Parsons, C.B., F.R.S.

It is proposed that Dr. Haddon, F.R.S., and Dr. W. H. R. Rivers be appointed to represent the University at the Universal Races Congress to be held in London in July.

LONDON.—Mr. Andrew Carnegie has given a donation of 5,000*l*. towards the building and equipment of the Institute of Medical Sciences of University College.

Sir Felix Semon has offered to the University for the foundation of a lectureship in laryngology the sum of 1,040*l*., being the amount presented to him by British laryngologists on his retirement from practice. The benefaction has been accepted by the Senate.

The degree of D.Sc. (engineering) has been conferred upon Mr. F. C. Lea, an external student, for a thesis on "Influence Diagrams as concerned with Stresses in Structures" and other papers, and the degree of D.Sc. in geology has been conferred on Mr. R. L. Sherlock, an external student, for a thesis entitled "Relationship of the Permian to the Trias in Nottinghamshire" and other papers.

It has been decided to invite the committee of the fifth International Philosophical Congress to hold the meetings of the congress in the University buildings in the spring of 1915. The following appointments have been made:—The principal (Dr. H. A. Miers, F.R.S.), representative of the University at the celebration of the centenary of the Royal Frederick University of Christiania in September, 1911; Prof. J. D. Cormack, governor of the Imperial College of Science and Technology (in place of Sir Arthur Rücker, F.R.S., resigned); Dr. Thomas Buzzard, governor of Westminster Hospital Medical School.

MANCHESTER.—To enable those taking up farming, estate management, or the teaching of agriculture to obtain a thorough scientific and practical training in agriculture, an arrangement has been made between the University of Manchester and the College of Agriculture and Horticulture, carried on by the Cheshire County Council at Holmes Chapel, by which a scheme for complete courses of instruction in agriculture has been established. A course of study leading to the degree of B.Sc. in agriculture or to the diploma of the Agricultural College may be pursued. The students take lectures and laboratory work in chemistry, physics, and biology, as well as special courses in agriculture, estate management, agricultural chemistry, agricultural botany, agricultural zoology (including entomology). The courses in agriculture and estate management and part of the course in agricultural chemistry and in botany are taken at the Agricultural College. A special prospectus has been prepared giving full particulars of the courses.

Prof. T. W. Richards, of Harvard University, who is to deliver the Faraday Lecture of the Chemical Society, is to receive the honorary degree of D.Sc. on July 8.

OXFORD.—Dr. H. L. Bowman, Waynflete professor of mineralogy, has been appointed secretary to the delegates of the University Museum, in place of Mr. H. Balfour, curator of the Pitt-Rivers Museum, who resigns the office next month.

Dr. W. T. Brooks, Christ Church, has been appointed Litchfield lecturer in medicine as from October next.

Mr. William Bateson, F.R.S., has been appointed Herbert Spencer lecturer for 1911.

THE Edward Kempton Adams research fellowship has been awarded by Columbia University to Prof. R. W. Wood, of Johns Hopkins University.

PROF. R. PATRICK WRIGHT, principal of the West of Scotland Agricultural College, has been appointed agricultural adviser to the Scotch Education Department.

WE learn from *Science* that Dr. E. B. Wilson has been designated Da Costa professor of zoology in Columbia University in succession to Prof. H. F. Osborn, who becomes research professor of zoology.

DR. H. WENHAM, of the Union Medical College, Peking, announces that for the first time in history the Chinese Government has granted a medical degree. Sixteen out of twenty-one candidates have passed the required examinations.

THE University Society of Nottingham and the East Midlands was formed on Saturday last at a meeting held at the Nottingham University College, the object of which is the furtherance of university education in the East Midland counties.

THE West Riding Education Committee has appointed Miss Helen M. Wodehouse to the principalship of the Bingley Training College, which is to be opened in September next. Miss Wodehouse is at present lecturer on philosophy in the University of Birmingham.

IT has been decided that Dr. Roberts, the secretary of the forthcoming Congress of the Universities of the Empire, shall visit Montreal in order to be present at the preliminary Conference of Canadian Universities, which is to be held in the first week of June, to ascertain the views of the Canadian universities as to the most suitable questions for discussion at the congress and to give any information respecting the steps that are being taken in the United Kingdom.

IN the April issue of *The Technical Journal*, which has now been received, a new series of articles on "Famous Technical Schools" is initiated with an illustrated description of the Glasgow and West of Scotland Technical College, by Drs. G. S. Cruikshanks and F. J. Wilson. It is proposed that the series shall not be confined to schools in the United Kingdom, but shall deal, so far as possible, also with the leading Continental and American schools.

THE fifth annual conference of the Association of Teachers in Technical Institutions will be held at Southport on June 5 and 6. Mr. Barker North, of the Bradford Technical College, will deliver the presidential address, and among the questions arranged for discussion are "The Organisation of Higher Technical Instruction," "The Representation of Teachers on Educational Bodies," "The National Organisation of Technical Education," and "The Salaries and Pensions of Technical Teachers." Further particulars of the conference may be obtained from the hon. secretary of the association, Mr. P. Abbott, The Polytechnic, Regent Street, W.

THE record of a notable achievement was contained in the final report of the building committee of the Glasgow and West of Scotland Technical College presented to a recent meeting of the governors. The committee reported the completion of the buildings, the foundation stone of which was laid in May, 1903. The buildings contain about seven acres of floor space, and the cubic contents amount to 7,292,382 cubic feet. Their cost, including professional fees and electric lighting and ventilating installations, was 272,329*l*, or less than 9*d*. per cubic foot, although they are of the most substantial fireproof construction. The portions of the site not previously in the possession of the college were purchased for the sum of 46,153*l*., and the equipment of the laboratories cost 34,746*l*., making a total expenditure of 353,228*l*. The whole expenditure involved in this large undertaking has been met without the incurrence of any debt. The college received grants from the Scotch Education Department of 88,660*l*., and voluntary subscriptions and donations amounting to 278,603*l*.; a balance of 14,000*l*. is therefore available to meet additions to the laboratory equipment now in course of construction or about to be ordered. These additions include an experimental steam turbine of the multi-stage impulse type and

of 200–250 horse-power; also a larger turbine of the reaction type. A high-speed paraffin engine of 40 horse-power and a four-cylinder petrol motor have been presented recently to the laboratory. The development of the college has kept pace with the increased accommodation. Last year a school of navigation was established, and its success has justified the governors in contemplating the purchase of a sea-going training vessel. A lectureship in sugar manufacture has also been instituted. Mr. Alfred Campion, who was appointed lecturer in metallurgy two years ago, has been raised to the rank of professor.

A MEETING of the Association of Teachers in Technical Institutions was held on May 20 at the Cardiff Technical School to consider the formation of a South Wales branch of the association. There was a representative attendance of technical teachers from Cardiff, Swansea, Newport, and the county of Glamorgan. An address was delivered by Mr. P. Abbott, the honorary secretary of the association, on "The Aims and Work of the Association." Mr. Abbott said technical education was the last branch of education to be organised, and consequently technical teachers were the last to band themselves together for the purposes of joint action. The organisation of technical education has not yet gone far, and it is probably safe to say that in this respect we are ten years behind Scotland and twenty years behind Germany. It must be recognised that conditions are changing, and that the extent of the prosperity of a country in the future will be determined more and more by the number of skilled and highly trained industrial experts that it possesses. If this work of organising technical education is to be efficient there must be cooperation. On one hand are those whose business it is to organise, administer, and finance technical education; on the other there are the teachers with an acquaintance with the calibre and the economic conditions of the students. The two classes are complementary, and for true progress the teachers must make their contributions to the solution of the problems involved. Facilities must be provided for the interchange of views and the formulation of opinions. Hence the association has the highest of all claims for the support of technical teachers. Mr. Abbott dealt at some length with the work done by the association, and especially in connection with examinations and curricula. In many respects, he said, the technical teacher is to-day in a relatively worse position than any other section of the teaching profession. Returns showed that the full-time technical teacher is usually paid worse than the secondary-school teacher. In conclusion, Mr. Abbott emphasised the national character of the association. A resolution was passed unanimously in favour of the formation of a South Wales branch.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society May 18.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. W. M. **Bayliss**: The properties of colloidal systems. II.—On adsorption as preliminary to chemical reaction. The existence of an "adsorption compound" containing acid and base uncombined chemically, and which can be isolated, is described, together with the manner of its conversion into the true chemical compound or salt. It is shown that a similar kind of compound is formed between an enzyme and its substrate, preliminary to the particular chemical change brought about by the enzyme in question. Adsorption between enzyme and substrate as affected by the presence of neutral salts is investigated, and found to follow the laws of "electrical" adsorption. The relation between the concentration of an enzyme and its activity is shown to be expressed by an exponential formula, the value of the exponent varying considerably according to circumstances. In certain conditions it may be unity, and in others the square root, but is usually between the two. Accordingly, the view that the rate of an enzyme action at any given moment is a function of the amount of the adsorption compound of enzyme and substrate in existence at that time is to be regarded as fairly well established.—S. M. **Jacob**: Inbreeding in a stable simple Mendelian population, with special reference to cousin marriage. The paper investigates, on the basis of Mendel's conception of the segregation of unit-characters, the proportions of different types among the offspring resulting from alliances of various degrees of inbreeding. A detailed examination is made of the consequences of first-cousin marriages, the form of inbreeding most frequently met with in actual human populations, while unions of other degrees of affinity, both those closer and those more remote, are also considered. The important point is brought out that for an evil which is a Mendelian recessive and is of common occurrence, a first-cousin marriage will not be much more likely to produce defective offspring than any other kind of marriage, but that a very rare recessive evil is relatively far more readily developed by such a consanguineous marriage. Now it is probable that there are very many of these rare defects latent in man. As the chance of a *particular* one of these appearing is increased by cousin marriage, the appearance of any random one of the large number is rendered much more probable by such a union. The same is true, on the Mendelian hypothesis, for any desirable qualities when such can be shown to be recessive. It is also established that the relative frequency of the appearance of the allogenic constituent in the offspring of related pairs diminishes by about one half for each grade of cousinship, so that the efficacy of cousin marriages in developing the recessive character diminishes with the grade of the marriage. In general, inbreeding accentuates both the pure dominant and the pure recessive strain to the same extent and at the expense of the hybrid element.—Miss M. **Wheldale**: The direct guaiacum reaction given by plant extracts. Previous work on oxidising enzymes has led to the interpretation of the direct blueing action in terms of the activity of a system consisting of an organic peroxide in conjunction with a peroxidase. The author finds that the power to give the direct action possessed by water-extracts of tissues is accompanied by another phenomenon, *i.e.* the formation of brown or reddish-brown pigments in the tissues on exposure to chloroform vapour. Both phenomena are characteristic of certain natural orders, but are absent from others or are characteristic of certain genera only in an order. When the direct action is not given, the plant extract will blue guaiacum on addition of hydrogen peroxide (indirect action), and the tissues do not show change of colour in chloroform vapour in the same period of time. The phenomenon of direct blueing of guaiacum is considered by the author to be the outcome of the presence of the dihydric phenol-pyrocatechin in the plants examined. Pyrocatechin is oxidised on the death of the tissues, and then acts as a peroxide, enabling the peroxidase, which is almost universally present, to transfer oxygen to the guaiacum. These conclusions are based on the following evidence:—(1) that pyrocatechin can be detected in plants (such as have been examined) which give the direct action and show change of colour in chloroform, whereas it cannot be detected in plants lacking these characteristics; (2) that solutions of both chemically prepared pyrocatechin and the actual plant product, after oxidation in air, will give a direct action with guaiacum and peroxidase only. The same result is not obtained with phenols having the hydroxyl groups in other positions. Hence the *direct* guaiacum reaction has, in all probability, no real significance as such in plant metabolism, but is merely the outcome of the presence of a certain metabolic product.—Dr. A. **Theiler**: Transmission of amakebe by means of *Rhipicephalus appendiculatus*, the brown tick. This is an account of experiments carried out at Pretoria, confirming the result arrived at by the Sleeping Sickness Commission during 1909, that the disease of calves in Uganda, known as amakebe, is in reality East Coast fever. It was arranged with the Government veterinary surgeon in Uganda, Mr. Hutchins, to send to Dr. Theiler nymphæ of *Rhipicephalus appendiculatus*, the brown tick, collected from calves in Uganda suffering from amakebe. On several occasions Mr. Hutchins forwarded ticks, which arrived at Pretoria alive and in good condition. The nymphs in transit moulted into the adult stage. Two experiments were performed to ascertain whether brown ticks, collected as nymphæ in Uganda from a calf suffering from amakebe, will transmit the disease when placed on susceptible calves in the

Transvaal. The first experiment, a bull calf, born and reared in Onderstepoort, was infested on January 23 with ten adult brown ticks, forwarded from Entebbe, Uganda, and received in the Transvaal on January 4. The ten ticks were found attached to the calf the following day. The animal died on the twenty-third day after tick infestation, and from the course of the disease and the *post-mortem* examination, a diagnosis of East Coast fever was concluded. Koch's bodies were found *post mortem* on microscopical examination of preparations of the lymphatic glands and spleen. The second experiment was carried out in a similar manner. On February 14 a calf was infested with ten adult brown ticks of the same batch, obtained from Uganda. On February 15 seven of the ticks were found attached. After an incubation period of thirteen days, a typical fever curve ensued. The animal died on the twenty-fourth day. During the course of the disease, Koch's bodies were found in the glands, and *Theileria parva* in the red cells of the blood. A diagnosis of East Coast fever was also concluded from the *post-mortem* examination in this case. Koch's granules were frequently found *post mortem* in the lymphatic glands and spleen.—S. J. **Meltzer**: Distribution and action of soluble substances in frogs deprived of their circulatory apparatus.—Dr. F. W. **Edridge-Green**: The discrimination of colour. If a definite portion of spectrum be isolated it will appear monochromatic, the size of the monochromatic region varying with the luminosity and wave-length of the light and the colour perception of the observer. Lord Rayleigh has expressed the opinion that he can discriminate between the colours in a monochromatic region even to the extent of distinguishing between the colours of the two D lines. The author does not find this possible when special precautions are taken to have a pure spectrum and to avoid the physiological effect of contrast through varying intensities of the areas to be compared. The monochromatic area may be magnified without altering its monochromatic appearance, the intensity of the light source being increased to compensate for the diminished luminosity. The monochromatic area may also be examined through a double-image prism, or be projected by means of a double-image prism upon a screen, so that the violet side of one area is adjacent to and just touches the red side of the other area. In this way the monochromatic area may be made as large as desired, the intensity of the source of light being increased as required. An arc light gives two very bright areas of colour. This method is the most favourable for the detection of any difference; the monochromatic areas, however, still remain monochromatic.

Royal Meteorological Society, May 17.—Dr. H. N. Dickson, president, in the chair.—Dr. H. R. **Mill** and C. **Salter**: The frequency and grouping of wet days in London. The purpose of this paper is to place on record certain facts, derived from the long homogenous records of rainfall kept at Camden Square, bearing on a recent scheme for insurance against rain risks. Days with a rainfall exceeding ·20 in. only are dealt with, as this is the limit adopted in several of the policies of insurance. The discussion is, of course, strictly applicable to London only, but it will probably apply fairly well to other inland stations in the south-east of England. The authors have examined a number of instances in which an insurance under one or two of the forms of policy offered would have resulted in a claim had a person in London insured every day for the week commencing that day during the whole period of fifty-two years. The actual compensation yielded by each 1*l*. invested during each seven-day period from 1859–1910 would have been as follows:—

Policy	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
A ...	8/8	6/5	6/10	4/1	4/9	11/3	10/7	11/1	10/1	18/10	15/9	11/1	10/-
B ...	9/1	8/6	7/10	7/7	9/1	11/3	11/4	10/10	10/-	13/10	12/8	10/8	10/9

E. **Mawley**: Report on the phenological observations for 1910. The most noteworthy features of the phenological year ending November, 1910, as affecting vegetation were the continuous and heavy rainfall in February, a sudden change from cold to warm weather in the middle of May, the great dryness of September, and the heavy rains and low night temperatures in November. During the greater part of the year wild plants came into blossom behind their usual time, the departures from the average being greatest at the end of April and the beginning of May. Such early spring migrants as the swallow, cuckoo, and nightingale made their appearance at about their usual dates. The only deficient farm crops were wheat, barley, and peas. On the other hand, the yield of oats, beans, potatoes, turnips, mangolds, and hay were above the average, and more especially beans, turnips, and hay. The crop of apples, pears, and plums was much under average, while all the small fruits, except strawberries, which yielded well, were also rather under average.

EDINBURGH.

Royal Society, March 20.—Prof. T. Hudson Beare, vice-president, in the chair.—Dr. J. R. **Milne**: Measurements on the scattering of light by "ground" glass. Certain preliminary experiments on the scattering power of various kinds of ground glass were described, as well as the form of apparatus which had been designed for the purpose of the research.—Margaret B. **Moir**: The magnetic properties of certain steels at moderate and high temperatures. The experiments were made in the physical laboratory of Glasgow University. In every case the specimen was rendered neutral at the new temperature previous to carrying out the tests. It is essential that this point should be attended to, and much of the previous work on magnetisation at various temperatures left a good deal to be desired in this respect. One result of interest was the discovery of a transformation point for carbon steel in the neighbourhood of 200° C. The changes in susceptibility which accompany the transformation are very distinct in cast iron and high carbon steels, not so marked for medium carbon steel, and imperceptible for soft iron.—Dr. J. A. **Gunn**: The pharmacological action of harmine. In this paper the actions of harmine were shown to be qualitatively very similar to those of harmaline, previously described by the author.

PARIS.

Academy of Sciences, May 8.—M. Armand Gautier in the chair.—P. **Appell**: The linkages expressed by the non-linear relations between the velocities.—Ch. **Lallemand**: The survey of the levels of Alpine valleys, with especial reference to the water-courses.—A. Michel **Lévy** and A. **Lacroix**: The materials of the rhyolitic and trachytic eruptive explosions of the volcano of Mont Dore. Details and discussion of two complete analyses of the rhyolitic pumice and four of the trachytic pumice.—A. **Müntz** and A. **Lainé**: The phenomena of the purification of sewage by the soil and by bacterial beds. It has been shown in a recent paper by the authors that in bacterial beds the destruction of organic matter by direct combustion takes place, and that this effect is greater than the nitrification. A study has now been made of purification by soil under ordinary agricultural conditions, and it has been found that the conditions of purification are different; in the bacterial beds combustion preponderates and nitrification is a secondary phenomenon, in soil nitrification predominates. The conclusion is drawn that soil is much superior as a nitrifying medium to bacterial beds.—M. **de Forcrand**: The hydrates of rubidium and cæsium fluorides.—Paul **Sabatier** and A. **Mailhe**: The catalytic decomposition of formic acid. From the reactions already known, formic acid might be expected to split up under the action of catalytic agents in three ways, giving carbon dioxide and hydrogen, carbon monoxide and water, or formaldehyde, carbon dioxide, and water respectively. The change into carbon dioxide and hydrogen is produced by platinum sponge, reduced copper, nickel, cadmium, and the oxides of zinc and tin. The second reaction is furnished by titanium dioxide and by the blue oxide of tungsten. Many substances, including thorium oxide, give all three reactions simultaneously.—L. **Cailletet**: The origin of the carbon assimilated by plants. The plants used in these experiments, according to the conditions of illumination, could take their carbon either from atmospheric carbon dioxide or from the organic material contained in the soil, or from both at once.—C. **Juel**: Simple cubic surfaces.—H. **Larose**: Trigonometrical developments with non-orthogonal components.—Georges **Rémoundos**:

The minimum modulus of integral functions.—M. **Riquier**: The existence of integrals satisfying given conditions along a contour.—Michel **Plancherel**: The application of Laplace's series to the method of summation of M. de la Vallée-Poussin.—Louis **Roy**: Viscosity in the motion of flexible wires.—H. **Vergne**: A development in series and its application to the problem of liquid waves by emersion.—L. **Hartmann**: The mechanism of the permanent deformation in metals submitted to extension. A description of the application of the method previously published to aluminium, nickel, two ferro-nickel alloys, copper-nickel, and other alloys.—J. **Olive**: Experiments made with the installation for aërodynamical measurements of the aviation establishment of Vincennes. The installation has for its object aërodynamical measurements on apparatus of full size displaced in calm air. Results are given for a Wright aëroplane.—M. **Rabut**: Partial tunnelling under the Rue de Rome and Boulevard des Batignolles. In the extension of the width of the line it was necessary to cut under these streets, portions of which were then supported on brackets of reinforced concrete.—L. **Houllevigue**: A radiation emitted in the interior of incandescent lamps.—A. **Leduc**: The work of magnetisation.—H. **Woltereck**: The production of ammonia and the economy of nitrogen in peat. It is shown that the treatment of peat by steam alone produces only one-third the quantity of ammonia obtained under similar conditions by the use of a mixture of steam and air.—G. **Charpy** and S. **Bonnerot**: The gases contained in steels. A source of error noted in these experiments was the slow evolution of gas due to a reaction between the heated metal and minute traces of water given off in the mercury pump. Extra precautions against this water vapour gradually diminished the continuous evolution of gas, but it could not be completely stopped.—Ed. **Chauvenet**: The action of carbon oxychloride on artificial and natural sulphides. The action of carbon oxychloride upon nine sulphides of different metals has been studied. The temperature of the reaction was in no case higher than 450° C., and in each case the normal chloride was the sole product. Examples are given of the application of the reaction in quantitative analysis.—F. **Bodroux** and F. **Taboury**: The bromination of some hydroaromatic compounds. Cyclohexane, prepared by the Sabatier and Senderens method, is not sensibly attacked by bromine in the dark at the temperature of the boiling point of the hydrocarbon. In sunlight the action is regular, hydrobromic acid being evolved and a good yield of cyclohexyl bromide being produced. Ultra-violet light cannot replace sunlight in this reaction. Higher bromine derivatives were also prepared.—M. **Lanfry**: A dinaphthothiophene.—P. **Freundler**: Researches on the oxyindazoles.—G. **Gauthier**: The synthesis of tertiary α-ketonic alcohols. Cyanhydrins are first prepared by the interaction of hydrocyanic acid and ketones, and these treated with an alkyl magnesium iodide. Three examples of the application of this general method are given.—A. **de Schulten**: The crystallographic examination of some fluorides obtained by M. Henri Moissan and his pupils.—V. **Vermorel** and E. **Dantony**: An anticryptogamic colloidal copper solution. Full details are given for the preparation of the new solution, which possesses certain advantages over those in current use.—M. **Marage**: Contribution to the study of consonants.—N. A. **Barbieri**: The mobility of neuroplasma.—Pierre **Lesne**: The battle against the caterpillar *Zeuzera pyrina*.—E. **Bataillon**: Embryogenesis provoked in the virgin egg of Amphibia by inoculation with the blood or sperm of a mammal. Traumatic parthenogenesis and impregnation without amphimixia.—MM. **Bordas** and **Touplain**: The original acidity of milk. The original acidity of milk, using phenolphthalein as indicator, is due exclusively to the free casein.—M. St. **Mostowski**: The glycogenic property of dioxyacetone.—E. **Kayser**: Beer yeast juice.

May 15.—M. Armand Gautier in the chair.—H. **Deslandres** and V. **Burson**: The laws relating to the movements of the solar protuberances. A study of the displacement of the K_3 line. The variations observed appear to correspond with the assumption that the velocity of rotation increases with the altitude, at least in the layers immediately above the chromosphere. No light has been thrown on the question as to whether the displacements east and west are equal or unequal.—J. **Carpentier**: The ophegraph, designed by M. Guillery. An account of an instrument for drawing tangents to a given curve by mechanical means. By means of this instrument, given a curve representing a function, the curve of the first differential of this function can be obtained graphically.—A. **Blondel**: Harmonic functions determined by certain conditions at the contour.—A. **Chatelet**: Abelian bodies of the third degree.—Ch. **Bertin**: A table of positions for purposes of navigation.—Captain **Duchène**: Good control of the aëroplane in air in motion. A description of two additions to an aëroplane, one designed for preserving longitudinal equilibrium, the other for transversal equilibrium.—M. **Yvon**: Cataphotography. Remarks on a recent publication of M. Guillaume de Fontenay.—Guillaume **de Fontenay**: Cataphotography. Acknowledging the priority of M. Yvon.—M. **de Broglie**: A particular case of distribution of ionisation in a gas. A very thin superficial layer containing ions of both signs. In the case of the ionisation of air by sulphate of quinine at the surface of the salt during the variations in hydration, there is an infinitely thin layer containing a high density of ions of both signs.—L. **Décombe**: A physical interpretation of non-compensated heat.—H. **Pélabon**: The resistivity of the selenides of antimony. From measurements of the specific resistances of various fused mixtures of antimony and selenium it was hoped to get some evidence as to the existence of definite compounds of these two elements. It was found, however, that the differences in resistance caused by tempering or annealing were so large that no definite conclusions could be deduced from the experimental figures.—A. **Rosenstiehl**: Some historical data relating to osmotic pressure.—Marc **Landau**: The action of the ultra-violet rays upon lactic acid. The gas evolved was mainly carbon dioxide, with some carbon monoxide. Ethyl alcohol, together with traces of pyruvic acid and an aldehyde, were detected.—Camille **Matignon**: The presence of zinc nitride in zinc dust and in commercial zinc. Zinc nitride appears to be present in all commercial samples of zinc dust. It is also met with, although in extremely small quantities, in certain solid zincs.—Pierre **Jolibois** and Eugène L. **Dupuy**: The definite compounds of arsenic and tin. From the metallographic study of a series of alloys of tin and arsenic only two compounds could be clearly defined. These had the composition of Sn_4As_3 and SnAs.—G. **Darzens**: A new method for the esterification of alcohols by the hydracids. The alcohol is treated with thionyl chloride and a tertiary base (B) such as diethylaniline, quinoline, or pyridine, when the reaction

$$R.OH + SOCl_2 + B = RCl + SO_2 + B.HCl$$

takes place quantitatively. A similar reaction with $SOBr_2$ gives good yields of bromides.—A. **Petit**: The fixing of phosphoric acid by the organic matter of the soil. Soils rich in organic matter do not fix any appreciable amounts of phosphoric acid.—Paul **Becquerel**: The supposed production of new plant forms by the method of traumatisms. The author concludes that neither in his own experiments with Zinnia nor those of M. Blaringhem with maize have new forms been really produced.—H. **Hallopeau**: The region of primary invasion of syphilis.—Albert **Berthelot**: Researches on di-iodotyrosine and its possible utilisation in therapeutics. Experiments made with 3 : 5-di-*l*-iodotyrosine showed that it is well tolerated by man and by animals, and promises to be a useful means of introducing relatively large quantities of iodine into the body without prejudicial after effects.—Jules **Amar**: Walking on an inclined plane.—P. **Achalme** and M. **Bresson**: The influence of the viscosity of the medium upon diastatic actions. An increase in the viscosity of the liquid, produced by the addition of glycerol, exerts a reducing influence on diastatic action which is very great compared with the variations introduced by other factors. The full discussion of the theoretical bearing of these experiments is reserved for a later paper.—Armand **Juillet**: Comparative observations on the relations between the lungs and the aërial sacs in birds.—J. **Wolff**: Some phenomena of reduction of oxyhæmoglobin. If the colouring matter is repeatedly reduced by ammonium sulphide and oxidised by shaking with air, after twenty-five or thirty times the

blood pigment is entirely destroyed. When, however, a biological reducing agent, such as the coccus obtained from a maceration of cheese, is employed, the alternate reduction and oxidation can be reproduced almost indefinitely.—Augustin **Wroblewski**: The soluble ferments of the brain. The presence of catalase, peroxydase, and lipase was proved.—Gabriel **Bertrand** and M. **Javillier**: The influence of zinc and manganese on the mineral composition of *Aspergillus niger*.—Jules **Stoklasa**: The physiological importance of manganese and aluminium in the plant cell.—R. **Lehmann** and C. **Vaney**: Percentages and qualities of the skins attacked by larvæ of Hypoderma in the Lyonnaise district.—Jules **Chalande**: Segmentary division in the myriopods.—E. **Roubaud**: The biological and morphological variations in *Stomoxe mutin* in tropical Africa.—A. **Gruvel**: Contribution to the systematic study of the Palinuridæ.—Pierre **Kennel**: The adipo-lymphatic bodies of some batrachians.—A. **Dehorne**: Nuclear permutation in the conjugation of *Colpidium colpoda*.—G. **Le Cadet**: The registration of a seismic shock by the large Richard barograph at the central Observatory of Indo-China.

DIARY OF SOCIETIES.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—Experiments on the Compression of Liquids at High Pressures: Hon. C. A. Parsons, F.R.S., and S. S. Cook.—Energy Transformations of X-rays: Prof. W. H. Bragg, F.R.S., and H. L. Porter.—Spectroscopic Investigations in connection with the Active Modification of Nitrogen. I. Spectrum of the Afterglow: Prof. A. Fowler, F.R.S., and the Hon. R. J. Strutt, F.R.S.—An Optical Method of Measuring Vapour Pressures; Vapour Pressure and Apparent Superheating of Solid Bromine: C. Cuthbertson and Mrs. M. Cuthbertson.—The Vacuum-tube Spectra of Mercury: Dr. F. Horton.—The Production of Characteristic Röntgen Radiations: R. Whiddington.

ROYAL INSTITUTION, at 3.—Air and the Flying Machine. II. Conditions of Safety for Floaters and Fliers: Dr. W. N. Shaw, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—N.W.F. Province of India: W. R. H. Merk.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Heating of Cables with Current: S. W. Melsom and H. C. Booth.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Phases of Bird Life. II. Migration: W. P. Pycraft.

ARISTOTELIAN SOCIETY (at Oxford in conjunction with Mind Association).—A Symposium on the Relation of Psychology to Metaphysics: G. F. Stout and A. Smith.

MONDAY, MAY 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Conditions affecting the Development of Canada: Prof. W. L. Grant.

ARISTOTELIAN SOCIETY, at 8.—A New Law of Identity: Miss E. E. C. Jones.

TUESDAY, MAY 30.

ROYAL INSTITUTION, at 3.—The Ancient Volcano of Charnwood Forest (Leicestershire): Prof. W. W. Watts, F.R.S.

WEDNESDAY, MAY 31.

INSTITUTION OF MINING AND METALLURGY, at 8.—Future Economies in Rand Reduction Plants: C. O. Schmitt.—The Roasting of Complex Ores in Gold Assaying: A. C. Hoare.—A Prospector's Method of Gold Assay: G. M. Austin.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis: Dr. R. Kennedy.—The Mechanism of Carbon Assimilation. Part III.: F. L. Usher and J. H. Priestley.—The Action of Radium Radiations upon some of the Main Constituents of Normal Blood: Miss Helen Chambers and Dr. S. Russ.—The Pathogenic Agent in a Case of Human Trypanosomiasis in Nyasaland: H. S. Stannus and Dr. W. Yorke.—The Experimental Transmission of Goitre from Man to Animals: Capt. R. McCarrison.

ROYAL INSTITUTION, at 3.—Changes Effected by Light: T. Thorne Baker.

RÖNTGEN SOCIETY, at 8.15.—On a Possible Therapeutic Use of Strongly Ionised Air: C. E. S. Phillips.—Photographic Action of the Positive Brush Discharge: Charles W. Raffety.

LINNEAN SOCIETY, at 8.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—A Flame Test for the Estimation of Oxygen and Black-damp in Naked-light Mines: Dr. J. S. Haldane, F.R.S.—An Experiment on the Effect of Reversing the Main Air-current: James Bain and Dr. J. S. Haldane, F.R.S.—Notes on Contrivances Designed to Prevent Overwinding, with some Instances of their Failure: W. H. Pickering and Granville Poole.—The Otto-Hilgenstock Direct-recovery Process and its Application: Ernest Bury.

FRIDAY, JUNE 2.

ROYAL INSTITUTION, at 9.—Radiotelegraphy: Commendatore G. Marconi.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

FORTHCOMING CONGRESSES.

MAY 30.—International Sanitary Conference (Prevention of Plague). Paris.

JUNE 28 and 29.—Conference on Education and Training of Engineers. London. President: Mr. Alexander Siemens, President of the Institution of Civil Engineers. General Secretary: Dr. J. H. T. Tudsbery.

JULY 11-22.—International Association of Seismology. Manchester. President: Prof. Arthur Schuster, F.R.S.

JULY 25-28.—British Medical Association. Birmingham. President: Dr. H. T. Buthn, Pres.R.C.S.

JULY 26-29.—First Universal Races Congress. University of London. President: Lord Weardale. General Secretary: G. Spiller, 63 South Hill Park, Hampstead, London.

JULY 29 TO AUGUST 5.—Congress of French Geographical Societies. Roubaix. President: Prince Roland Bonaparte.

JULY 30 to AUGUST 2.—Annual Meeting of the Swiss Society of Natural Sciences. Soleure. President: Dr. A. Pfaehler. Inquiries to Secretaries: Dr. Küng (German) and Prof. Brönnimann (French).

AUGUST.—Centenary of the Foundation of the University of Breslau.

AUGUST 12-1[illegible].—First International Congress of Pedology. Brussels. President: M. Alexis Sluys. Secretary: M. Vital Plas, 35 Avenue Paul de Jaer, Brussels.

AUGUST 13-20.—Prehistoric Society of France. Nîmes.

AUGUST 31 TO SEPTEMBER 6.—British Association. Portsmouth. President: Sir William Ramsay, K.C.B., F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 4-6.—Centenary of the University of Christiania. President of Festival Committee: Prof. Brögger.

SEPTEMBER 9-20.—International Congress of the Applications of Electricity. Turin. President of the Committee of Honour: H.R.H. the Duke of the Abruzzi. Honorary Secretary of the Committee: Signor Guido Semenza, Via S. Paolo 10, Milano. International Secretary: Col. R. E. Crompton, C.B., R.E., Crompton Laboratory, Kensington Court, W.

SEPTEMBER 24-30.—International Congress on Tuberculosis. Rome. Address for inquiries: Honorary Secretary of the National Association for the Prevention of Consumption, 20, Hanover Square, W.

CONTENTS.

PAGE

THURSDAY, JUNE 1, 1911.

AFRICAN VEGETATION.

Die Vegetation der Erde. Sammlung pflanzengeographischer Monographien. By Prof. A. Engler and Prof. O. Drude. ix., Die Pflanzenwelt Afrikas, insbesondere seiner tropischen Gebiete. Grundzüge der Pflanzenverbreitung in Afrika und die Charakterpflanzen Afrikas. By A. Engler. Band i., Allgemeiner Überblick über die Pflanzenwelt Afrikas und ihre Existenzbedingungen. 1 Hälfte (Heft i.), pp. xxviii+478. 2 Hälfte (Heft ii., und iii.), pp. xii+479–1029. (Leipzig: W. Engelmann, 1910.)

THE botany of Africa, especially of tropical Africa, has for the last twenty years attracted much attention among systematists, both in this country and on the Continent of Europe. The important and exhaustive "Floras" of South and Tropical Africa organised at Kew have, after a period of abeyance, progressed steadily towards completion. Many books and papers dealing with more restricted areas have been published, such as the enumeration of Dr. Welwitsch's Angolan collections, the important work on the vegetation of German East Africa, edited by Dr. Engler, of Berlin, and Dr. Wildemann's finely illustrated volumes on the botany of the Congo region. The results of various expeditions, many of which have been largely due to individual effort, have also added much to the botanical literature of this great continent. Towards the achieving of these results no one has worked harder or displayed greater zest than Dr. Engler. Not only has he made good use of the members of his staff at the Berlin Botanical Museum in working up the great mass of material which has been collected chiefly from the German colonies, but has also himself made botanical expeditions in various parts of the continent. Dr. Engler was therefore eminently fitted to prepare a general account of the vegetation of Africa, and the two substantial volumes in which this account is embodied form a valuable addition to the important series of monographs on plant geography issued under his own and Prof. Oscar Drude's editorship.

The greater part of the book, to be precise 870 out of a total of 1019 pages, is occupied with the introduction, a general review of the vegetation of the continent. This takes the form of a series of chapters descriptive of the vegetation of as many areas differing largely in size and importance. Chapter i. (pp. 1–50) deals with Mediterranean Africa, from Morocco to Egypt, and the Sahara. Chapter ii. (pp. 51–478), "Tropical East Africa to Eastern Capeland," deals with the vast area extending from Nubia and Somaliland to the Karroo district of Cape Colony, and includes among its principal subdivisions the Abyssinian flora, the floras of the Somali peninsula, of the Masai highlands, of German East Africa, Nyasaland, Portuguese East Africa, Rhodesia, the east Kalahari district, and the Karroo. The rich and characteristic flora of south-west Cape Colony forms the subject of the third chapter, while the fourth—"the extra-tropical and tropical summer-rain district of West Africa"—is concerned with the enormous area stretching from Namaqualand and Hereroland to Senegambia, and including the Huilla highlands, Angola, the Congo basin, the area of central tropical Africa from the Upper Congo to Uganda and the Great Lakes, the Ruwenzori district, the Cameroons (treated in some detail), Central Guinea or Togoland, Upper Guinea, and Senegambia. The fifth and last chapter deals with the vegetation of the Cape Verdes, the Canary Islands, and Madeira.

A perfect uniformity of treatment of these numerous and widely different areas, some only of which have been indicated above, could not be expected, and Dr. Engler is naturally most exhaustive in dealing with provinces the botany of which he has had most opportunity of knowing, namely, those under German government in East and West Africa. But his review as a whole forms a valuable *résumé* of the work which has been done on the botany of the various parts of the African continent, and gives, so far as is possible from the data to hand, a useful account of the chief characteristics of their vegetation. It shows not only what has been done, but, a matter of equal importance, what still remains to be done. Perhaps the most striking feature of this portion of the work is the wealth of illustration; the pictures occupy almost if not quite as much space as the text. There are more than fifty whole-page plates, beautiful photographic reproductions of vegetation, plant associations, or landscape. In addition there are more than 700 text figures, many of which occupy a full page; these illustrate habit or form of individual plants, or are botanical analyses of one or more species. The illustrations alone give a good idea of the characters of the vegetation of the district under discussion. Mention should also be made of the carefully elaborated list of botanical collectors classified according to districts, which precedes the text proper. Associated with this is a map indicating the routes and collecting stations of the more important collectors. Three other maps illustrate the vegetation of German South-West Africa, the Cameroons, and Togoland respectively.

The comparatively small portion of the book which remains after the introduction, is divided into four parts. Part i. deals mainly with climate—temperature and rainfall—of the tropical and north and south extra-tropical areas; it also includes a chapter on the nature of the soil. Part ii. gives a brief general account of the vegetation of a series of altitudinal regions—tropical rain forest, tropical steppe region, subtropical bush and grass region, subtropical high forest region, and subalpine and alpine regions. Part iii. deals similarly with the various formations—halophilous, including littoral and interior (such as occur in the Sahara in the north, and the Kalahari in the south); hydrophilous, including alluvial forest, marshland, lake, and river vegetation; hygrophilous megatherm, the evergreen rain-forest vegetation; hygrophilous mesotherm—the bamboo forest, high mountain bush, and damp meadow vegetation of the higher regions of the tropical mountains or the slopes

of the subtropical; subxerophilous, such as occur in districts with a short rain season of three to four months or a limited mist formation—a very extensive and diverse series, including the grass steppes at different altitudes, the dry wood- and bush-formations, and subalpine and alpine areas; and, finally, the true xerophilous formations. The fourth and last part contains an elaborate series of lists of orders and genera displaying the various component elements of the African flora, such as a general tropical element, palæotropic, African - Asiatic, African - Malagasy, American-African, Mediterranean-African, endemic tropical, and others. There is also a short sketch of the development of the African flora.

The difficult problem of indexing so extensive and elaborate a sytematic work has been solved by supplying an exhaustive table of contents and by confining the index to names of plants which are figured in the text.

A. B. R.

THE ALTERNATE-CURRENT TRANSFORMER.

Transformers: a Treatise on the Theory, Construction, Design, and Uses of Transformers, Autotransformers, and Choking Coils. By Prof. H. Bohle and Prof. D. Robertson. Pp. xiv+356+Tables A and B+18 plates. (London: C. Griffin and Co., Ltd., 1911.) Price 21*s.* net.

THIS very complete treatise on the alternate current or static transformer will no doubt be found of considerable value in the drawing office of practical transformer builders, and also by teachers and advanced students. Whoever uses it, however, will have to possess time and patience as well as very good eyesight to master the symbolical notation the authors have seen fit to employ, which to most ordinary readers will prove in certain respects exasperating. In dealing with simple periodic or variable quantities, such as alternating currents, electromotive forces, and fluxes, a widely used custom has been adopted of employing small letters for instantaneous values and corresponding large ones for the maximum values, and either brackets or bars over a letter to denote R.M.S. values. The authors of this book have adopted the plan of printing a little ᵗ inside the capital letter to denote the instantaneous value, and a little ᴹ to denote the maximum value. These special symbols are for most eyes quite illegible without the aid of a magnifying glass, and can only be described as producing the maximum amount of eye and mind strain to read them.

Again, most mathematical writers now employ block letters or clarendon type to signify vectors, but the authors of this book have turned their backs on this useful practice, and used block letters such as **T** and **N** to signify scalar quantities such as time, or mere numerics such as number of turns. This may seem to the non-mathematician to be a small matter, but at a time when an International Committee is endeavouring to obtain something like order and uniformity in technical symbolisation, it is a great pity for any authors to display an exuberance of ingenuity in devising symbols which have never been used before, and are not likely to be used again.

Apart, however, from the difficulties of perusal introduced by this deviation from beaten paths, the authors have produced a book which has many valuable qualities. It is characterised by admirable illustrations prepared from photographs of actual transformers, parts, and appliances, and also by excellent plates giving working drawings of transformers in use, which are rendered all the more useful by appended millimetre and inch scales.

There are also a large number of curves delineating the co-variation of pairs of important quantities.

The book is divided into twelve chapters covering general principles, magnetising and no-load currents, losses in transformers, temperature rise, magnetic leakage, transformer vector diagrams, systematic testing, insulating materials, examples of construction, design of transformers, applications of transformers, and polycyclic systems. Having regard to the fact that so much has been written on the subject of transformers, there is a remarkable absence of all references, either in footnote or text, to the work and writings of previous authors.

The subject of the alternate-current transformer has been treated from the point of view of theory and of the student with such completeness in the works of Blakesley, Fleming, Kapp, Bedell, Bedell and Pierce, Rhodes, and many others that the chief room for addition seemed to be in a practical treatise on the design of transformers, giving rules for the systematic predetermination of all dimensions and quantities to a prescribed specification.

This the authors have done in their chapter x., and have added also complete worked out specifications for transformers and choking coils of various sizes and types. These, however, would have been rendered more valuable if the actual results of tests of these transformers had been given to show how far the predetermined values agree with measured ones.

The chapter on testing of transformers seems deficient in not laying sufficient stress upon the measurement of secondary drop or giving good methods for determining it at all loads. When transformers have to be banked to work in parallel, the identity in their drop curves is most important, as otherwise one or more transformers may be overloaded or may overheat. Bragstad's and Kapp's diagrams for transformer regulation are, however, given and explained in the chapter on transformer diagrams.

It would require much time and, in addition, considerable expense to check or test the formulæ given by the authors for dimensions of transformers to comply with certain specified requirements, but the results are for the most part embodied or condensed into tables, which the practical transformer manufacturer can speedily bring into comparison with practice. The book, however, in many respects fills a distinct gap in transformer literature, and will no doubt be of great use to draughtsmen who are responsible for overhauling or improving a line of stock transformers to reduce cost or improve their working. It only remains to add that the book is excellently printed, and in this respect a model of what technical publications should be.

THE FEEDING OF CROPS AND STOCK.

The Feeding of Crops and Stock. An Introduction to the Science of the Nutrition of Plants and Animals. By A. D. Hall, F.R.S. Pp. xvi+298. (London: John Murray, 1911.) Price 5s. net.

THIS volume is the third of a series by Mr. Hall dealing with some of the scientific aspects of farming, and, like the preceding treatises, on "The Soil" and "Manures and Fertilisers," gives an exceedingly clear and able exposition of the principles of crop and stock feeding, valuable alike to student, teacher, and practical farmer. It might be well if Mr. Hall would at a convenient time consider the rearrangement of the series, as at present there is some overlapping of subjects which is particularly noticeable in the present volume.

The first four chapters are devoted to the study of the growth of and the chemical changes occurring during the growth of plants. The important points in this process are illustrated by simple experiments which can be performed without the aid of complicated apparatus, and which we particularly commend to teachers of "nature-study" in our elementary and secondary schools. Chapters v. to viii. deal with matter which is more fully elaborated in Mr. Hall's work on "The Soil." Chapters ix. to xi. break fresh ground in dealing with the animal and its food requirements, whilst chapters xii. and xiii. are digests of Mr. Hall's treatise on "Fertilisers and Manures," the last chapter, xiv., containing a short account of the composition of milk and other dairy products.

The subject of the feeding of animals is one to which we could wish the author had devoted more space. Rothamsted has a wealth of results of its researches on the feeding of plants, but the subject of animal feeding has not received the same attention, though by this it must not be understood that extremely valuable work in that direction has not been accomplished, but it is a sad fact, appreciated by all workers in agricultural science, that in England we have no well-equipped station for the carrying on of necessary research in animal nutrition. The United States and Continental nations have seen the importance of such work, and the experimental work of these countries is rich in results, of which Mr. Hall has made excellent use, and we feel confident that had Rothamsted the equipment for such work which its reputation and the *personnel* of its present staff deserve, our knowledge of the feeding of animals would be greatly increased, to the benefit of the stock feeders of the country. Will not some friend of agriculture come forward and establish at Rothamsted a digestion calorimeter and endow its efficient service?

Mr. Hall has, in the work under review, disposed of many fallacies with regard to plant and animal nutrition, and we would commend to all practical men the pages dealing with the valuation of foods and the use of the various constituents of foods in the stages of fattening. (An omission in proof correction of the first few lines of p. 181 in speaking of the cottoncakes may give rise to some misunderstanding.) To the stock farmer it will be obvious that there is much in the book to interest, and if not to instruct him, at least to explain the principles on which his good practice depends, and to the arable farmer there is also much which, from the purely practical point of view, may show the way to economics in manuring by a well-reasoned explanation of the influence of manurial constituents on plants having differing range of root action, differing periods and durations of growth, and differing final products to build up. Such an important point as the quality of wheat is elaborated, with a due consideration of all the factors, and one-time accepted theory that the order of the evaluation of the protein and starch is the cause of the wide variations in quality between strong Canadian and weak English wheats is regarded as untenable.

As has been already stated, many formerly accepted theories are rejected, and sound reasons brought forward for their rejection, the reasons for crop rotations, the acid excretion by roots, the changes induced by ensiling, the use of preservatives for farmyard manure, effect of food on milk, are among many changes of opinion which have been brought about by accurate researches into cause and effect, and although the practical man is apt to be bewildered by these changes of opinion and to be somewhat sceptical as to the accuracy of present theories, the fault lies with those who have in the past hastily enunciated reasons without due consideration of all the factors, not to those who, like the author of this book, demand that a theory shall be not merely a plausible explanation of phenomena, but something which will rigorously satisfy all requirements, and the truth of which can be demonstrated by an appeal to accurate experiment.

M. J. R. D.

PATHOGENIC INSECTS.

Insects and Disease: a Popular Account of the Way in which Insects may Spread or Cause some of our Common Diseases. By Prof. R. W. Doane. Pp. xiv+227. (New York: H. Holt and Co.; London: Constable and Co., Ltd., 1910.) Price 1.50 dollars net.

IN this volume, which gives evidence of considerable research, Prof. Doane has presented the first collective narrative, in popular form, of the principal results which have been achieved in relation to insect-borne diseases, both in man and his domesticated animals. And in order that the layman may the more readily understand the biological relations of the various pathogenic organisms and their intermediary hosts, the author has briefly reviewed some of the more salient points in relation to their structure and life-history; in this way it is believed that the most complex inter-relations may be followed clearly.

Prof. Doane has met a great want in producing this unpretentious volume, in which he has successfully collated the overwhelming evidence of the maleficent agency of certain insects and other allied animals in the dissemination of disease. We feel, however, that he has been a little too credulous in some few instances in accepting evidence which is

not of a thoroughly convincing nature, all the more so, seeing that the work is primarily intended for the layman, who has not the means of sifting out such matter and putting the correct interpretation upon it. Thus in dealing with Malta fever, in a few short sentences he would lead the reader to infer that mosquitoes often serve as the "inoculating" agents, and unfortunately leaves one entirely in the dark as to the true cause of the spread of this disease.

Many of the photographic illustrations which accompany this work are very good; indeed, more especially so are those representative of the various developmental stages of the mosquitoes; we do not agree with the author's statement, however, that all his pictures show "the insects, not as we think they should be, but as they actually are," because both colour values and general morphological characters are in many instances entirely wanting, and the resulting print is nothing more than a silhouette. Moreover, the photographs of both museum and microscopical preparations show a marked absence of care and neatness in the display of the various organs, and such figures as these stand out in marked contrast to those of Manson, Kellog, Nuttall, and others. We would point out also that Figs. 76 and 77 represent a female and male mosquito respectively, and not the reverse order, as stated by the author. *Ochromyia anthropophaga* (p. 49) should read *Auchmeromyia luteola*. The latter, not the former, is the parent of the congo-floor maggot.

This work is furnished with an extensive and useful bibliography occupying forty-seven pages, to which annotations are appended.

SYSTEMATICS.

Die taxonomischen Grenzen der Art und ihrer Unterabteilungen. Versuche einer genauen Definition der untersten systematischen Kategorien. By Andreas Semenov-Tian-Shansky. Pp. 24. (Berlin: R. Friedlaender and Son, 1910.) Price 2*s*.

THIS is the German translation of a pamphlet which appeared first in Russian. It deals on a wide basis with the definition of the term species and the lower categories in classification. The author —whose title, "Tian-Shansky," reminds us of his exploration of the Tian-shan or Celestial Mountains in Central Asia—pleads for uniformity of terminology in the various branches of botany and zoology, and then proceeds to examine critically the opinions of various botanists and zoologists on the criteria of species and its several component varieties. The large experience gained by Semenov from his many years' study of insects, especially Coleoptera, and his acquaintance with at least an essential portion of the literature bearing on the subject, enable him to substantiate his criticisms by illustrations drawn from his own knowledge and to adduce corroborative evidence from the writings of other authors. The co-existent species are defined by the author as units which are morphologically and psycho-physiologically separated from each other. The units thus isolated do not fuse, although very occasional intercrossing may occur. The individuals belonging to a species may all be practically alike, or they may form various kinds of varieties. Semenov defines four principal categories of modifications within a species:—

1. Subspecies or geographical race (*subspecies*) is the most important subdivision of a species, inasmuch as it represents a phylogenetic stage one degree below the complete separation from the parent stock.

2. Nation (*natio*) is a term proposed by Semenov for local varieties which are subdivisions of a subspecies, each *natio* occupying only a comparatively small definite portion of the whole area of the subspecies.

3. Morph (*morpha*) is adopted for the non-geographical varieties which are produced by the action of the seasons, the soil or the food.

4. Aberration (*aberratio*) is employed for purely individual deviations from the normal type.

It appears to us so very difficult and often impossible to draw in nature a distinction between subspecies and nation (=sub-subspecies) that in many cases the employment of one or the other term will entirely depend on the personal opinion of an author. The Greek term *morpha* does not appeal to us as a happy choice, and will hardly recommend itself to systematists generally, who are used to the Latin term *forma*, often employed with a convenient qualifying addition, such as *f. temp.*, for the seasonal form.

The pamphlet is a lucid interpretation of the distinguished author's view, and will be read with great profit by all who are interested in the philosophical aspect of systematics.

K. J.

COORDINATE GEOMETRY.

An Elementary Treatise on Coordinate Geometry of Three Dimensions. By R. J. T. Bell. Pp. xvi+355. (London: Macmillan and Co., Ltd., 1910.) Price 10*s*. net.

THE substance of this volume has formed the material of a course of lectures delivered for some years past to undergraduates in Glasgow. Its object is to provide the student, whose bent is towards applied mathematics, with as complete an exposition of the subject as he will require, and at the same time to act as an introduction to those who intend to proceed to a more exhaustive study of differential geometry and the theory of surfaces. Its scope is best indicated by a brief enumeration of the headings of the chapters:—coordinates, direction ratios, the plane and straight line, change of axes, the sphere, the cone, the conicoids, axes of sections, generating lines, confocals, the general equation of the second degree, systems of conicoids, conoids and general surfaces, curves in space, ruled surfaces, curvature, geodesics. It will be noted that there is no mention of homogeneous and tangential coordinates. The author has excluded these on the ground that the student has already acquired a knowledge of the general principles involved from his work in plane geometry. The same consideration has led him to exclude any section on duality or reciprocation. Some teachers will regret this omission, as the student is

always interested in the extension of general processes from two to three dimensions.

For those who are studying the subject with little or no external assistance, this is certainly an admirable text-book. The writer is evidently fully conscious of the kinds of difficulties that beset the inexperienced student. The expository work is excellent throughout, but in particular we may direct attention to the section on the discriminating cubic, the chapter on the intersection of conicoids, and the treatment of tortuous curves, which is always a serious stumbling-block at a first reading. Easy numerical examples are freely provided throughout the text to illustrate the working of each new idea. We are particularly glad to see that a fairly complete set of answers has also been supplied. At the end of each chapter there are sets of harder examples, which include some of considerable difficulty, and the book closes with a useful index.

Within the limits which the author has chosen the volume will be found comprehensive, thoroughly trustworthy, and eminently lucid. Those who have had much to do with higher school work or the junior students at the universities have felt for some time the need of a new text-book on solid geometry. We have no doubt that lecturers and tutors will find this volume most useful for their pupils, and we shall not be surprised if a welcome is extended to it from abroad.

PHYSICAL CHEMISTRY.

Traité de Chimie générale. By Prof. W. Nernst. Ouvrage traduit sur la 6e édition allemande. By Prof. A. Corvisy. Première Partie. Propriétés générales des Corps. Atome et Molécule. Pp. iv+510. (Paris: A. Hermann et Fils, 1911.) Price 12 francs.

IN the movement associated with the rapid development of general chemistry during the last twenty-five years, the apathy displayed by a considerable section of French chemists affords a striking contrast to the activity and enthusiasm which has marked the progress of physical chemistry in other countries. For this state of affairs there can be little doubt that the chief factor responsible is to be found in the influence of the older generation of chemists, whose attitude towards the problem involved in the operation of chemical forces has been determined largely by a patriotic adherence to the doctrines of Berthelot. Signs are not wanting, however, that the resistance, which has been offered to the spread of more rational and modern views, is rapidly decreasing.

The translation of the sixth edition of Nernst's well-known work cannot fail to accelerate the acceptance of these views, and the service rendered by the translator in bringing this classical treatise within reach of the average French student of chemistry is no mean one. Since the appearance of the first edition of the work, published in 1893, the book has undergone many alterations, and by appropriate additions the author has contrived to maintain its character as a thoroughly modern treatise of general chemistry.

Amongst such changes may be noted a more detailed treatment of the molecular theory in its application to the liquid and gaseous states of aggregation on the basis of the van der Waals's and the reduced equations of condition. Considerable modifications have also been made in dealing with the subject of electric conduction, and more particularly with the phenomenon of conduction in gases. The recent rapid progress of knowledge in the domain of colloidal chemistry has also necessitated an extension of the chapter dealing with the colloidal state, and a short section is devoted to the consideration of radioactivity. In this, the author's aim is not so much that of recording the epoch-making discoveries which have been made in recent years, as to show the general bearing of the ideas, which have resulted from these investigations, on the atomic and molecular theories.

As an exposition of the general properties of matter the book occupies a unique position, and the rapid sequence of new editions in the original language is a fitting testimony to the widespread recognition of its intrinsic merits in the country of its origin.

As in the case of many other German publications, exception must be taken, however, to the comparative neglect of the work of physical chemists in other countries. This is doubtless more or less accidental, but it is a matter to which attention might be given by the author in the event of the issue of further editions or translations. The present translation claims to be a faithful reproduction of the German, and, as such, the translator's task appears to have been carried out in a highly commendable manner.

OUR BOOK SHELF.

Elements of Analytical Geometry. By Prof. G. A. Gibson and Dr. P. Pinkerton. Pp. xxi+475. (London: Macmillan and Co., Ltd., 1911.) Price 7s. 6d.

IT is too often the custom to regard analytical geometry and analytical conics as synonymous terms. Most introductory treatises on Cartesian methods limit their scope to the investigation of properties of curves of the second degree, and it is left to writers on the calculus to supplement this course with a brief mention of the nature and functions of a few higher plane curves. A preliminary course in the use of fundamental formulæ is clearly essential, but so soon as facility in expression and interpretation has been acquired, it is both instructive and interesting for the student to realise their application, not merely to the conic, but to curves of a more general character. We therefore welcome the insertion of a chapter, following immediately after a thorough treatment of the straight line and circle, which introduces the student to the conchoid and cissoid simultaneously with the conic. The next sixty pages are devoted to the investigation of the shapes of curves which have simple algebraic equations of the type $y=f(x)$, with special reference to turning values and asymptotic forms. In some respects, simplicity would be secured by a more direct appeal to the methods of the calculus than the authors care to adopt. Such a treatment as is indicated in Mr. Mercer's recent text-book, entitled

"The Calculus for Beginners," will present little difficulty to those who are sufficiently mature to be able to appreciate the comprehensive work of the present volume, and the consequent abbreviation of analysis will render more prominent the principles which are being illustrated.

Owing to the general character of the structure of this book, it is not until page 318 that we first meet the systematic discussion of the equations of the three species of conics, reduced to their standard forms. These are taken together, and the importance of parametric notation is shown here as in the earlier parts of the book. We are glad to see that Joachimsthal's section-equation is employed for tangent and polar properties, not only because the method is intrinsically instructive, but also on account of its application to homogeneous coordinates. The final chapter gives a brief sketch of the theory of the general equation of the second degree, and a few properties of confocal conics and curvature. The authors have excluded line coordinates, homogeneous coordinates and invariants as being beyond the scope of their work. We have no hesitation in describing this text-book as an excellent introduction to Cartesian methods.

Bathy-Orographical Map of the World on Gall's Projection. (Edinburgh and London: W. and A. K. Johnston, Ltd., n.d.) Prices: Varnished, 12*s.*; unvarnished, 10*s.*

IN showing elevation on a map of the world generalisations are essential, but detail and accuracy must not be sacrificed for the sake of graphic effect if such a map is to have any practical value in teaching. On this map three areas are distinguished in colour on the land, above 5000 feet, 1000 to 5000 feet, sea level to 1000 feet, and below sea level. The 5000 feet line has been inserted with considerable care, and gives a fairly true representation of the main regions of high land, but some further distinction is needed between regions of great elevation, such as Tibet, and moderate heights, such as the Drakensbergen. It must be remembered that the principal use of a world map of this kind will be in connection with the study of climate. The absence of any higher elevations is against its use for, to take two examples, the study of the influence of elevation on temperature and that of high marginal ranges, such as the Himalayas, on wind movements and rainfall. That the map is intended to be used in the study of climate may be judged from the fact that inset maps are given of mean annual temperature and of rainfall. An exception must be made to the statement of the general accuracy of the map with regard to the higher elevations in Canada and Alaska. The result of recent observations has not been incorporated in the case of N.E. Canada, N. and S. of Hudson Strait, in which region are situated the highest mountains of the eastern part of N. America, and the accuracy of the Rockies and coast ranges of the N.W. leaves much to be desired when contrasted with that of the W. of the United States.

The next contour is at 1000 feet, which, in the case of countries such as Africa, largely above that elevation, is at too distant an interval to give an adequate representation of the land surface. A curious error has been made in the case of Great Salt Lake, which is shown as below sea-level. The sea depths are indicated at 100, 2000 and 3000 fathoms, but it is doubtful if these lines, which do not correspond to those shown on the land, will be of much use for the general study of land forms. On the whole it must be said that the map is of little use for advanced geographical work, and is too crowded with unnecessary names for elementary teaching.

Plant-Animals: a Study in Symbiosis. By Prof. F. Keeble. Pp. ix+163. (Cambridge: University Press, 1910.) Price 1*s.* net.

ALTHOUGH notices of two of the small volumes in this series have already appeared in NATURE, it has not been precisely indicated that they are early volumes of a new series of short works, dealing with scientific and literary subjects, and intended for the lay as well as for the professional reader, that was initiated last year by the enterprising University Press of Cambridge. The contribution by Mr. Keeble is particularly appropriate to the series as it represents a complete story, replete with instructive problems and a definite piece of research that has entailed persistent observation, ingenious experiment, and cautious interpretation of results.

The research covers the peculiar life-history of two lowly worms, *Convoluta roscoffensis* and *Convoluta paradoxa*, that inhabit the foreshores of Brittany, where they were studied in the sea and in a small laboratory. The first section of the book relates to their structure, rhythmic movements, and periodic seasons of reproduction, and contains an excellent discussion of their sense attributes as influenced by light, gravity, and memory (mneme). The plant element, in the shape of enclosed green or yellow-brown cells, is considered in the second part of the book, with regard to action, origin, nature, and significance, leading to the conclusion that they are reduced algal cells of the family Chlamydomonadineæ Instructive as are the facts, quite as much so are the observations, experiments, and arguments from which the conclusions are derived. In fact, it is difficult to say whether one admires more the patience and ingenuity displayed, the careful sifting of evidence, or the logical yet popular exposition. The booklet should be quite understandable to and interest non-scientific readers, yet few botanists will fail to glean information and ideas from its pages.

An Elementary Treatise on Conic Sections by the Methods of Coordinate Geometry. By C. Smith. New edition, revised and enlarged. Pp. x+449. (London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.*

THE merits of this book are so well known that comment is almost needless. Nearly thirty years have passed since it was first published, and since then a few additions have been made from time to time, as experience has suggested. The latest edition is considerably enlarged. The number of illustrative examples has been increased; a section on envelopes has been inserted at the end of the chapter on the parabola; and a concise sketch of the theory of invariants of two conics is given in the concluding chapter. There are many other minor additions which will be found useful, such as occasional paragraphs on points of book-work, which have been hitherto regarded as problems, and three sets of miscellaneous examples.

For scholarship purposes in our opinion, this book is without a rival. The earlier portions are scarcely full enough for the novice, who probably requires a more extensive numerical introduction to the subject. But as soon as this initial stage is completed, it is quite certain that he cannot do better than turn to this text-book and read it from cover to cover.

There are, of course, some features which are open to criticism. The chapter on tangential coordinates is so compressed that a student may fail to appreciate the power of line coordinates and the analytical interpretation they offer of the principle of duality. Again, many teachers would prefer a direct appeal to the methods of the calculus in tangent properties;

and, lastly, we believe that considerations of simplicity render it desirable to replace trilinear by areal coordinates. To avoid overburdening the memory it is advisable to restrict the student at first to one or other of these systems, and in this case we have little doubt that areals should be regarded as the primary system. These are, however, scarcely more than mere matters of detail, and it is not difficult for the teacher to supply the remedy, if he feels it is needed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Forest of Auchnacarry.

BOTANISTS and many others will be very sorry to hear that a large part of what remains of the old forest of Scots firs at Auchnacarry has been sold to the timber merchant, and that the whole of it is likely to be felled ere long. The forest lies in the west of Inverness-shire, near Loch Askaig, on the first, or one of the first, of the glens that run westward from the Caledonian Canal, just north of Fort William. It is on the great estate, and near to the mansion house, of Cameron of Lochiel. While not so old as, for instance, the historic trees of the New Forest, or as that strange grove of oaks at Wistman's Wood, the Scots firs at Auchnacarry are of deep interest and value as perhaps the largest and finest fragment that is left to us of "primæval forest," neither planted nor tended by the hand of man. Its area is about 1500 acres, and the trees are of immense size, being mostly from 200 to 300 years old; the largest have a circumference of about 18 feet at 5 feet from the ground, and the dimensions of a very large number are said to be little less. The scenery of the forest is of great beauty, marking the difference that exists between the natural look of self-grown timber and the stiff, unvaried lines of an artificial plantation. In England we think of the Scots fir as an uninteresting, and even unsightly, tree, unpleasing in colour and often cumbering the ground (as in parts of the New Forest) to the exclusion of more picturesque trees. It is usually planted, as Gilpin said in his "Forest Scenery," "in thick array, which suffocates or cramps them, and if they ever get loose from their bondage they are already ruined." Very different from this description are the beautiful glades at Auchnacarry, where (to borrow words from Sir T. Dick Lauder), "We have seen it towering at full majesty in the midst of some appropriate Highland scene, and sending its limbs abroad with all the unconstrained freedom of a hardy mountaineer, as if it claimed dominion over the savage regions around it." And, to quote Gilpin once again:—"When I speak of the Scots fir as a beautiful individual, I conceive it when it has outgrown all the improprieties of its youth; when it has completed its full age, and when, like Ezekiel's cedar, it has formed its head among the thick branches."

The forest of Auchnacarry is, save for a few isolated trees or small surviving clumps, all that we know to remain of the great forest of Scots fir that once spread over all suitable ground in central Scotland from Ben Nevis to the Spey. There was immense and wholesale destruction of these forests in the latter years of the eighteenth and earlier years of the nineteenth century, owing to the needs of the shipbuilder and to the high price of Baltic timber during the Napoleonic Wars. It was then, for instance, that the great forest of Rannoch was cut down, which, from the borders of Argyll, Perth, and Inverness, stretched far and wide across the country to link with the forests of the Spey, the Findhorn, and the Beauly, as well as with those of the "Great Caledonian Glen." The forest of Glenmore on the Spey was purchased of the Duke of Gordon by a Hull timber merchant in 1783, and out of it he built and launched at the mouth of the Spey "forty-seven sail of ships, of upwards of 19,000 tons burden, the largest of them of 1050 tons." A plank from this great felling is, or was, preserved at Gordon Castle, 6 feet long by 5 feet 5 inches broad. In the early part of last century there still remained large portions of the forest of Rothiemurchus, where for many years together a great income was yielded by the timber, sometimes, it is said, more than 20,000*l*. a year. There were also great stretches left of Lord Seafield's forests of Abernethy and Duthel, though a great part of the former had been destroyed by fire just after the rebellion of 1745. But in these and others the axe was already busy, and nowadays, though here and there a few ancient trees remain, the present writer knows of nothing that is left to us so noble and so extensive, so

Scots Firs at Auchnacarry.[1]

worthy of preservation as a relic of an older Scotland, as this doomed forest of Lochiel's at Auchnacarry. There is much ado when a great picture leaves the country; but to the naturalist and to all tree-lovers the destruction of this ancient forest will seem a greater loss, greater because the object is unique and the loss irreparable.

D. W. T.

The End of the *Beagle*.

DR. WATASE, professor of zoology in the College of Science of this University, has directed my attention to a letter on this subject in your issue of December 9, 1909. In view of the Darwin centenary celebrations of the year before last, and wishing to be fully assured of whatever facts were known regarding Darwin's *Beagle*, Dr. Watase got me to write to my old friend Mr. N. E. Smith, C.B., of the Comptroller's Department, Admiralty, Whitehall. The reputed tonnage (B.O.M.) of the vessel bought by Japan was known to be 523; her length and breadth were variously stated as 150 feet by 25 feet 6 inches and 160 feet by 26 feet. Mr. Smith very kindly traced the following notes with regard to Darwin's *Beagle* and to a subsequent vessel of the same name. His conclusion is that the *Beagle* bought by Japan was not Darwin's, but the later vessel. His letter is as follows:—

"The *Beagle* in which Darwin made the voyage round the world was a 10-gun brig-sloop built at Woolwich in

[1] For this photograph we are indebted to the proprietors of the *North British Agriculturist*.

1820. This *Beagle* was sold, by public auction, to Messrs. Murray and Trainer, for 540*l*., in May, 1870, having for some years previously served as watch vessel at Southend.

"The next vessel of the name was a first-class gun vessel (screw), built at Blackwall in 1854 and carrying 4 guns. This vessel was serving on the East Indies and China Station in 1862, and in the Navy List of that year is shown as 'ordered home'; but in the following year she disappears from the list, and in Parliamentary Paper No. 560 of Session 1867 ('Navy—Ships sold') she is entered as 'sold abroad' in 1863, for 5500*l*. Inquiry has been made of the Contract and the Accountant-General's Department as to whether she was bought by the Japanese, but no information on this point is available, all such records of the period having been destroyed. Doubtless, however, this is the *Beagle* to which the inquiry refers.

"The following are the dimensions of the respective ships:—

	Beagle built in 1820.	*Beagle* built in 1854.
Tons	235	477
Length—		
Gun deck	90	160
Keel for tonnage ...	$73\cdot7\frac{5}{8}$	$143\cdot4\frac{3}{4}$
Breadth, extreme ..	24·8	25·4
Breadth for tonnage ...	24·6	25
Depth in hold	11	13·3
Light draught—		
Afore	7·7	5·10
Abaft	9·5	8·1

"Initialled W. E. S., 15.12.09."

F. P. PURVIS.

Engineering College, Tokyo Imperial University of Japan, May 9.

Distant Orientation in the Amphibia.

ROMANES, in his book on "Animal Intelligence," suggests that frogs have a distinct idea of locality, and he also expresses the opinion that frogs are able to perceive moisture from a great distance. One of his correspondents found that frogs removed from their habitual haunts for 200 or 300 yards returned to them again and again. Romanes quotes Warden, who, in his "Account of the United States," says that when a pond containing a number of frogs dried up, the animals "made straight for" the next water, though it was 8 kilometres away. During the spring of 1910 I made a series of experiments, which have been continued this year, with the view of settling how newts are able to find their way back to water when they have once left it or have been removed from it. Working with the Palmate newt (*Molge palmata*, Schneid.), I got no evidence of a faculty for the perception of moisture at a distance, and in order to explain the spring migrations of the newt it is unnecessary to presuppose its presence, because I certainly think there is a small homing faculty. My results directly point to this. Romanes gives no details, and more information on this question would be welcomed before I draw up a full account of the experiments. The subject has an important bearing on the psychology of the Amphibia, and must form when elucidated an interesting chapter in their natural history; yet the reference in Romanes is the only one I can find.

BRUCE F. CUMMINGS.

Cross Street, Barnstaple, N. Devonshire, May 14.

A Zenith Halo.

WITH reference to Mr. Gold's letter in your issue of May 11 concerning the halo observed by Mr. Kreyer, I should like to make the following remarks. I think Mr. Gold is quite right in assuming that the phenomenon observed was the so-called arc of contact of the halo of 46° radius, which for this altitude of the sun is really almost in contact with that halo, whereas, according to Bravais's theory, supported by numerous observations by Ekama and Besson, for lower altitudes these arcs may be separated by as much as 7° (with the sun at the horizon even 12°). But I think Mr. Gold is mistaken in assuming that the centre was at 80°, or 85° altitude.

Mr. Kreyer's observation that the arc formed part of a circle with the zenith as apparent centre is quite in harmony with Bravais's theory and the numerous observations in our country. Even Pernter, who accepts Galle's theory, besides that of Bravais, does not bring conclusive evidence of the existence of arcs in the same altitude with their centre outside the zenith. It is much more probable that Mr. Kreyer's estimate of 10° or 15° has been too low, as is usually the case with the estimates of arcs near the zenith, and that the real radius was about 20°.

These circumzenithal arcs are not of so little frequent occurrence as one might think from Mr. Gold's letter. Messrs. Besson and Dutheil have observed them at Montsouris 111 times in the course of ten years, and the Dutch staff of voluntary observers sixty-seven times in the same period.

In recent years the observations have been even more numerous in our country. The period 1904–8 gives fifty-five days with observations of circumzenithal arcs; 1904, even thirteen observations by one and the same observer. Perhaps the high altitude of the halo is the reason why it is rarely seen by unskilled observers.

E. VAN EVERDINGEN.

Meteorological Institute, De Bilt (Holland).

THE object of my remarks on Mr. Kreyer's observation was to make it clear that the phenomenon belonged to the class due to refraction through ice-crystals. For that purpose the exact position of the centre of curvature of the arc was immaterial, and in the absence of accurate measurements an altitude of 80° to 85° was sufficiently near the observer's estimate of 90°. Dr. van Everdingen suggests that the radius of the arc may have been 20° instead of 10° to 15° as estimated by the observer. I agree with him, and indeed I thought of suggesting this in my notes, but it seemed just as likely that Mr. Kreyer had made a slight error in estimating the altitude of the centre, and I did not regard the matter of sufficient importance to call for a discussion of the alternatives.

The interest of observations such as those of Mr. Kreyer, where the positions and distances are estimated only, does not rest on the support which they may give to the theory of Bravais or to that of Galle, but now that Dr. van Everdingen has reopened this question, I am sure meteorologists would welcome from him a discussion of the two theories in the light of the more extensive observations to which he refers, which no doubt contain the measurements necessary to prove or disprove the horizontality of the arc.

E. GOLD.

Meteorological Office, South Kensington, London, S.W., May 20.

The Yale.

THE animal upon which Prof. Hughes has based the sketches published in NATURE of May 25 (p. 415) is evidently the typical, or white-tailed, gnu. But this is a South African species, the northern limit of which is formed approximately by the Vaal River. How, then, can it represent an animal the home of which was supposed to be Ethiopia? The brindled gnu of East and North-east Africa has horns of an entirely different type. I may add that if Prof. Hughes can definitely identify "the antelope" he will perhaps kindly communicate his information to those who are less fortunately situated in this respect than himself.

R. L.

Apple Blossoms.

THERE is a theory that the retardation of the flow of sap tends to the production of fruit as against wood buds, and this retardation for apple and pear trees is effected in various ways—by root-pruning, cutting of the bark, for example.

Now last year the want of sunlight, I think, tended to weaken the vitality of trees, and so tended to retard the flow of sap. Should we not, then, expect this year to find an *excess* of fruit buds? The "show" of apple blossom round us, in Gloucestershire, is exceptionally profuse.

F. C. CONSTABLE.

THE RECENT CENSUS OF ENGLAND AND WALES.

IN reply to a question put by Dr. Addison, the President of the Local Government Board gave on May 24 a preliminary statement as to the results of the recent census. The figures, which are based on summaries furnished by the local registration officers, are, of course, of a provisional character, but it is not probable that any serious errors are involved.

The total population of England and Wales is returned at 36,075,269, as compared with 32,527,843 in 1901, a gain of 10·91 per cent. This compares with increases of 12·17 and 11·65 per cent. in the two preceding decades, and is the lowest percentage increase recorded in any decade since the commencement of the nineteenth century. It would seem to imply a loss of nearly half a million by excess of emigration over immigration.

The population of the administrative county of London shows an actual decrease, from 4,536,267 to 4,522,961, illustrating the almost universal outward trend of urban populations as the facilities for locomotion increase. The population of the "outer ring"—*i.e.* that portion of London which lies within the Metropolitan Police District, though outside the administrative county—has grown from 2,045,135 to 2,730,002, and the populations of the counties of Essex, Middlesex, and Surrey have increased by 30, 42, and 30 per cent. respectively.

The same tendency is clearly exhibited by many of the returns for the County Boroughs. Few show an actual loss of inhabitants; Canterbury, Halifax, Hastings, and Burton-on-Trent are the only towns coming under this category. Many, however, show only a very slight growth, notably Birmingham, with an increase from 523,000 to 526,000 only during the ten years. Coventry forms the most striking exception to the general rule of slackening growth, with its increase from 70,000 to 106,000, largely due, no doubt, to the motor industry. To realise the general nature of the changes, the figures given in the present return should be compared with the populations estimated by the Registrar-General for last year; these estimates are based on the rate of growth exhibited by each district during the preceding decade, and in the case of the great majority of the boroughs are in excess, often seriously in excess, of the true population even at the present time. The population of Bristol was estimated last year, for example, at 383,000; the census figures show only 357,000. That of Leeds was estimated at 491,000; the census enumerators could only find 446,000. That of Leicester was estimated at 248,000, against a census return of 227,000, and of Sheffield at 479,000, against 455,000.

The present return reinforces, in fact, the lesson that has been so often drawn by statisticians as to the necessity, both for a more frequent census, and for the use of better methods of estimating populations during the intercensal intervals. Many of the County Boroughs, and many of the Metropolitan Boroughs, have been credited during the last ten years with a fall in the death-rate far more rapid than they could lay claim to, owing to the consistent over-estimation of their populations; and this rapid fall has been used not only as the basis for natural self-congratulation by the local medical officers of health, but also as a foundation for party posters in county council elections. Quinquennial censuses would largely reduce the margin of error; the use of methods of estimation based on local information, *e.g.* those recently suggested by Mr. E. C. Snow, (referred to in a Note on p. 459), would narrow it still further. So many improvements in the form of the returns have been introduced during the new *régime* at the Registrar-General's office, that we feel some confidence in expecting a change in this respect. At present the figures given for birth- and death-rates in the annual summaries and reports are often, towards the end of an intercensal decade, very gravely misleading.

INDUSTRIAL BURSARIES.

THE Royal Commission for the Exhibition of 1851 propose to establish industrial bursaries for young men who, after a course of training in a university or approved technical college, desire to enter engineering, chemical, or other manufacturing works. The bursaries are intended to enable suitable applicants to tide over the period between their leaving college and obtaining remunerative employment in industry. The value of the bursary will depend on the circumstances of the candidate, but will as a rule not exceed £100 a year. A bursar will be elected in the first instance for one year, but the tenure of his bursary will ordinarily be prolonged for a second year provided that the Commissioners are satisfied with the work done by the bursar during his first year. In special circumstances a bursary may be renewed for a third year.

The appointments to the bursaries will be made by the Commissioners from among candidates recommended by the authorities of certain selected universities and technical schools, and in dealing with these recommendations great weight will be given to evidence that a candidate has the practical abilities likely to lead to his advancement in manufacturing work, academic success alone being an insufficient recommendation.

The candidate must be a British subject, under the age of twenty-five, and must have been a *bonâ-fide* student of science for a term of three years.

The candidate must further satisfy the Commissioners:—

(*a*) That he has obtained, or can, within one month of election, obtain a post in some engineering or other manufacturing works approved by them.

(*b*) That he is in need of pecuniary assistance to enable him to accept such a post.

A bursar may, if the Commissioners approve, spend part of the tenure of his bursary in studying a special industrial process or processes in works either at home or abroad.

No bursar shall enter a firm as a premium pupil without the special consent of the Commissioners.

A bursar must submit a report of his work to the Commissioners on the expiration of each year of his bursary.

The institutions invited to nominate in 1911 are as under:—University of Edinburgh; Heriot Watt College, Edinburgh; University of Glasgow; Glasgow and West of Scotland Technical College; University of St. Andrews; University of Aberdeen; University of Birmingham; University of Bristol; University of Leeds; University of Liverpool; University of Manchester; Armstrong College, Newcastle-upon-Tyne; University College, Nottingham; University of Sheffield; University of Oxford; University of Cambridge; University of London; Imperial College of Science and Technology; University College of Wales, Aberystwyth; University College of North Wales, Bangor; University College of South Wales and Monmouthshire, Cardiff; Royal College of Science for Ireland; Queen's University of Belfast; University College, Cork; University College, Galway.

THE NATURALIST'S PICTURE GALLERY.[1]

MR. KEARTON'S bird pictures are so well known that it is unnecessary to say much about his latest work, beyond indicating its scope and object, except that the pictures are larger than usual, and, if possible, more beautifully reproduced. This work has been prepared at the request of friends who have expressed a wish for Kearton pictures from nature on a larger scale of reproduction, and in order to give the man or woman, boy or girl, who knows but little of the countryside a bright and stimulating glimpse of the wild creatures dwelling therein. But it will not be to these alone that this sumptuous volume will appeal. Those who know our birds and beasts best will probably appreciate it more than anyone else, for to them these beautiful pictures of their old friends will be an unfailing joy and delight.

Upwards of fifty birds and beasts and reptiles are portrayed, and to each is devoted a pleasant descriptive article. First and foremost this is a picture book (wherein birds, beasts, and reptiles jostle together without system, as they jostle in nature's own domain), as its title implies; but the text, although of secondary importance, is as accurate, informatory, and interesting as care and experience can make it. Familiar wild birds and beasts find a place here side by side with the very rarest birds that visit our islands to breed. Mist-wreathed mountains and quiet hedgerows, the restless sea and peaceful meadow, the deep woods and the towering sea cliffs, have all been visited to find these pictures. Altogether the author is fully justified in his belief that the work will form the finest gallery of sun pictures of wild birds and beasts, taken amidst their natural surroundings, ever published in this or any other country.

FIG. 1.—Nest of the Dotterel in a slight natural hollow. From "Kearton's Nature Pictures."

Amid so much excellence we cannot help directing particular attention to the beauty and interest of the plates showing young thrushes, the peewit, trout, oyster-catcher, tree pipit finding a young cuckoo, and the great black-backed gull. A finer picture of a grand-looking bird in its native haunts than this last we never saw. Mr. Kearton has secured some excellent and characteristic photographs of that little-known reptile, the natterjack toad. This, we imagine, was no easy task. For we remember trying to help a famous photographer to secure some picture of the natterjack on a hot morning among the sand-dunes on the coast of Holland, and how often our efforts were frustrated by the extreme activity of the toads, one of the points in which it differs from the more familiar squat toad of our gardens. By permission of the publishers we reproduce two of the illustrations.

FIG. 2.—Oyster Catcher. From "Kearton's Nature Pictures."

[1] "Kearton's Nature Pictures," beautifully reproduced in Photogravure, Colour, and Black and White from photographs by Richard and Cherry Kearton. With descriptive text by Richard Kearton. Vol. i., pp. viii+96. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1910. Price 15s. net.

WILD PARAGUAY.[1]

EL GRAN CHACO is the name of that great, low-lying alluvial plain, which is situated where the Republics of Paraguay, Argentina, and Bolivia meet. Extending over 200,000 square miles, it is populated, but for a mere fringe of white settlements, entirely by Indians, the total population of whom is estimated at not more than 135,000. Many futile attempts have been made by the Spaniards to explore this vast district, or to "reduce" the fierce native tribes to the white man's ways; they ended mostly in massacres of the exploring parties, and the Chaco was therefore left severely alone until within quite recent times. Even the Jesuit missions in the middle of the eighteenth century had fared badly; futile also was the attempt made by Captain Allen Gardiner, founder of the South American Missionary Society, to settle among the Tobas in the year 1870, and it was not until the year 1889 that the same society succeeded in establishing a mission among the Chaco Indians.

W. Barbrooke Grubb, then quite a young man, was sent out and entrusted with the seemingly hopeless task. For twenty years this pioneer and marvel of devotion has lived amongst the savages, at first quite alone, later on joined by helpmates. The present book deals mainly with the events and experiences of the early five lonely years amongst the Lengua tribe, a little to the west of the Paraguayan town of Concepcion. Now there is a flourishing mission, called Waikthlatingmangyalwa, the place where Prof. J. G. Kerr and the late J. Budgett got their material for the mudfish Lepidosiren. It is safe for the white man to traverse some 200 miles west of the river Paraguay, over roads cut by the missionaries; thousands of cattle are now tended by Indians, where but a few years ago men, who had acquired lands, scarcely dared to inspect them for fear of these same Indians. In these parts Grubb's is a name to conjure with, and the Paraguayan Government fully acknowledge what they owe to this man by having made him Commissary-General of the Chaco, with the additional title of "Pacificador de los Indios."

FIG. 1.—Procuring Fire by Friction. From "An Unknown People in an Unknown Land."

How has he achieved it? By living alone with these savages and almost like one of them, learning their language and customs, without worrying them, but all the time trying to understand what is really at the back of the Indian's mind. Gradually they in turn came to look upon him not as a harmless lunatic, but to respect him. It was uphill work, and not without danger; as for that matter, one of his trusted and most intelligent friends shot an arrow into him, and left him for dead, several days' journey from the nearest native village. This foul deed enraged the native community so much that they ultimately caught the would-be murderer, killed him, and burnt his body to ashes. There is no other record of a Chaco-Indian being slain by his own tribesmen for the murder of a white man.

The greatest difficulty in gaining the confidence of the natives was the opposition of the medicine-men, or witch-doctors, utterly ignorant but shrewd humbugs, who, of course, saw at once that their power would wane as much as the white man's reasoning influence ascended.

The many long years spent with these hitherto almost unknown people have enabled the author to give us a narrative from the point of view of seasoned experience, instead of first impressions, and thus it has come to pass that chapter after chapter, as they deal with the mode of life, rites, and beliefs, are so many essays of ripened authority. It may, however, be regretted that many of the revolting features, and most of their rites are inclined that way, are scarcely hinted at, and that the question of sex is but lightly

[1] "An Unknown People in an Unknown Land": an Account of the Life and Customs of the Lengua Indians of the Paraguayan Chaco, with Adventures and Experiences met with during Twenty Years' Pioneering and Exploration amongst them. By W. Barbrooke Grubb. Edited by H. T. Morrey Jones. Pp. 330. (London: Seeley and Co., Ltd., 1911.) Price 16s. net.

touched. The Lenguas, being strong believers in reincarnation, are convinced that the soul of a deceased person hovers about his old haunts, watching for the opportunity of slipping into some living person. Such a chance is provided when a man dreams, because then his soul is wandering, and these people suffer terribly from dreams, so much, indeed, that it may be questioned whether a more rational diet, or medical relief from indigestion, would not have at least accelerated the painfully slow process of religious conversion. This reincarnation doctrine leads to such ludicrous mental conditions that a man in full vigour may be in doubt whether he is himself or not, asserting gravely that his own real soul is at a distance, being kept away by devils, and that some other, departed, soul has crept into him!

Owing to the custom of infanticide, especially of girls, the men are in the great majority, with the result that every girl has a wide selection of partners.

FIG. 2.—Blanket Weaving. From "An Unknown People in an Unknown Land."

Further, native law requires that the man must leave his own people and join those of his wife. Her main object in life being to feed well and to have as little drudgery as possible, she seeks a mate of a mild disposition, who will be subservient to her rule, besides being a good hunter and gardener. There is a delightful chapter on the baneful result of communalism, socialist principles being carried to such perfection that the lazy bodies will neither hunt nor fish as long as there is something to eat elsewhere, because it is a strict law that all shall share in everybody else's spoil.

The author's profits of this remarkable and well-illustrated book will be devoted to the support of the Church of England South American Missionary Society.

PROF. M. H. N. STORY MASKELYNE, F.R.S.

PROF. MERVYN HERBERT NEVIL STORY MASKELYNE, whose death on May 20 was announced in last week's NATURE, was born on September 3, 1823, and was the son of Anthony Mervyn Story, F.R.S., who married the only daughter of Nevil Maskelyne, the famous Astronomer Royal. The family is thus one of scientific distinction through three generations, and it is not surprising that Maskelyne was early in life attracted to the study of science. He went to Wadham College, Oxford, where he took his degree in 1845, and even in those early days all his spare time, energy, and resources were devoted to the pursuit of chemistry, at a time when there were very limited facilities for the study of science at the university.

In 1856 Maskelyne succeeded Buckland, and became professor of mineralogy, and held that office until the year 1895. He had a laboratory and residence under the Old Ashmolean Buildings, and was one of the chief workers in experimental chemistry in Oxford. He was indeed urged by many persons to be a candidate for the chair of chemistry, which became vacant in 1855, but was not willing to stand in opposition to his friend, Benjamin Brodie. He played a prominent part in the establishment of science teaching in Oxford, and was secretary of the first committee formed to promote the scheme for building a university museum. Some of his reminiscences of that period are related in Dr. Vernon's "History of the Oxford Museum," where it is stated that his classes in analytical chemistry were attended, amongst others, by Thomson, afterwards Archbishop of York, and Henry Smith.

In 1857 he became keeper of the department of minerals in the British Museum, and for twenty-three years combined this office with his Oxford professorship. The keepership of the mineral department he resigned in 1880, when he became Liberal member of Parliament for Cricklade, and afterwards for North Wilts, until the year 1892, when he retired from active political life. Referring to his father's death, he wrote, "it was like a whirlwind that bore me from the museum, where my life would have been impossible, to this country life and into the House of Commons."

Maskelyne's scientific activity was for the greater part of his life in the field of mineralogy, and especially crystallography, and his interests were largely centred in the development of the great collection of minerals at the British Museum. In particular, he brought together the wonderful collection of meteorites which for years has maintained its position as the best, or one of the two best, collections in the world. Much of his time was devoted to the scientific study of these remarkable objects. In 1850 Mr. Sorby had laid the foundation of the modern study of rocks by showing that it was possible to grind sections of them so thin as to be transparent, and Maskelyne was the first to apply the new method to the study of meteorites, and was able by the microscope to identify in them many terrestrial minerals and to discover some which are unknown on earth.

Although in the study of higher physics and mathematics he must have been mainly self-taught, it was towards the physical and crystallographical sides of mineralogy that he was particularly attracted. Mineralogy had become an exact science in the hands of Haüy at the close of the eighteenth century, and Whewell and his eminent successor Miller kept alive in Cambridge the mathematical treatment of crystallography.

It was Maskelyne's work to develop in particular the subject of the symmetry of crystals, upon which he gave a course of lectures before the Chemical Society in the year 1875. Victor von Lang, who subsequently became professor of physics at Vienna, had

been his assistant in the British Museum for a short period (1862–4), and his suggestive book, published in 1866, was one of the first dealing with this subject; much that appeared in the books of both authors was doubtless the result of their discussions during this period.

Maskelyne's own "Treatise on the Morphology of Crystals" did not appear until 1895, the year in which he resigned his professorship in Oxford, but much of it had been written thirty years before, and, if it had been published at that time, the book would have been regarded as a highly original treatise. The proof sheets were familiar to many of his students, and introduced them to a very attractive treatment of what was then a new subject. Owing to the late appearance of this book, his methods were chiefly made known to the world in an indirect way through his pupils, and it is possible that he may not have received the credit that is due to him. For example, it is mentioned in Lewis's "Crystallography" that the mathematical establishment of the angles possible between planes of symmetry in a crystal was first given by Maskelyne in his lectures in 1869, but no publication of such a result was made until that by Prof. Gadolin in 1871.

Among those who worked with him at the British Museum, in addition to his old friend von Lang, were Thomas Davies (1862–80), who was responsible under him for the arrangement of the "Collections"; Dr. Walter Flight, F.R.S. (1867–80); W. J. Lewis (1875–7), now professor at Cambridge; and his successor, Lazarus Fletcher (1878–80), now director of the Natural History Museum. He always spoke with particular admiration of Grailich, of Vienna, who was an early and intimate acquaintance. One of his dearest friends was that remarkable man, Henry Smith, of Oxford, with whom he frequently discussed mathematical problems. It was the good fortune of the present writer, when an undergraduate, to receive instruction from Maskelyne in an informal way in Henry Smith's house; on these occasions the lecture was delivered from an armchair in the drawing-room, Smith himself playing the part of a second student, and illuminating the discourse by questions and comments of profound significance. An example of the stimulus which Maskelyne's active mind gave to those with whom he came in contact is the investigation by Smith of the conditions under which lines in a crystal can be perpendicular to each other.

It is not necessary here to give a detailed account of Maskelyne's scientific papers. They range over a wide field, and are characterised by a charm of literary style which is well known to all who received letters from him. His activities date from so early a period that it is difficult now to ascertain what personal part he played in some of the scientific discoveries of the middle of the nineteenth century, but he worked for a time in Faraday's laboratory at the Royal Institution, was one of the earliest to take a practical interest in the newly invented process of photography, and, indeed, throughout his long life interested himself in almost every branch of scientific inquiry.

Faraday stayed with him during the British Association meeting at Oxford in 1847, when, he writes:—"I showed Faraday for the first time the making and developing of a photo of the College Quad from the window. His joy was that of a boy."

Maskelyne's interests outside science were also very wide, and he was the owner of one of the best and most carefully selected private collections of antique engraved gems; his catalogue of the Marlborough gems, which was privately printed, is well known.

He possessed a remarkable elasticity and alertness of mind, as of body, even in advanced years, and his enthusiasm for all that was new in science, literature, and art was maintained to the end. Only four years before his death he was occupied on a scientific handbook for the use of the dairy farmers of Wiltshire, and was well known throughout the county as a man whose intellectual activities were always available for a good cause. Everything that he did was evidence of his taste, and was marked by a conspicuous refinement and distinction of style and manner.

In a letter written only three years ago he said:—"I think there must be some cement in the smaller sciences like mineralogy and crystallography that links their students by a bond unlike the relations that exist between the advocates of the larger sciences; jealousies and rivalries seem to hold aloof, and certainly from the days of Grailich and Lang to those of my old age some of my dearest and most honoured friends have come to me through the sciences that you and I have professed at Oxford since 1856."

It was in reality his own warm, impulsive, quick-tempered, and sympathetic nature which united him by the closest ties of affection to so many of his pupils and scientific friends. The charm of his manner and the astonishing versatility of his mind were the qualities that most impressed those who met him in the later years of his life.

He received the honorary degree of Doctor of Science at Oxford in 1903, and the Wollaston Gold Medal from the Geological Society in 1893. He was an honorary fellow of Wadham College, and a corresponding member of several foreign societies. In 1858 he married a daughter of Mr. J. D. Llewelyn, F.R.S.; she survives him, together with three daughters, one of whom married the late Mr. H. O. Arnold-Forster, and another Sir Arthur Rücker. H. A. M.

MRS. W. P. FLEMING.

BY the death of Mrs. Williamina Paton Fleming, astronomy has suffered an almost irreparable loss. Concerning the general spectral classification of stars Mrs. Fleming had accumulated a store of knowledge which was second to none.

Born at Dundee, Scotland, in 1857, she became an assistant at the Harvard College Observatory, Cambridge, Mass., in 1879, and in 1898 was officially appointed as the curator of astronomical photographs, a department wherein Harvard holds a unique position. Here Mrs. Fleming was charged with the supervision of a number of ladies whose duty it is to examine minutely, and to classify, the ever-growing library of plates taken at the Cambridge and Arequipa stations. Her special personal labours were chiefly devoted to the study of the enormous number of stellar-spectra plates which form the Draper Memorial. This collection was commenced in 1886 as a memorial to the late Dr. Henry Draper, and consists of an immense number of photographs of stellar spectra taken with the 8-inch and 11-inch Draper telescopes. Each plate covers a comparatively large area, and contains the spectra of a large number of stars, and when we learn, from Prof. Pickering's latest report, that there are now 18,182 plates taken with the 11-inch, and 36,852 taken with the 8-inch telescope, it is easy to understand that Mrs. Fleming's task was no light one.

The chief result of these studies was, perhaps, the production, in 1890, of the "Draper Catalogue of Stellar Spectra," in which Mrs. Fleming classified the spectra of 10,351 stars down to about the eighth magnitude. This Durchmusterung, with its revision,

will probably long remain unexcelled as a comprehensive, comparative study of the broad features of stellar spectra. Its magnitude prevents it, of course, from dealing with the individual spectra in detail, but it stands not only a memorial to Dr. Draper, but also to the patient and specialised studies of Mrs. Fleming.

The minute examination of such a wonderful collection of photographs afforded great opportunities for discovery, and right well did Mrs. Fleming and her staff avail themselves of them. Of the eighteen novæ discovered since 1885, fourteen first stood revealed on the Harvard photographs, by reason of their characteristic spectra; of these, ten were found by Mrs. Fleming.

The first nova thus found was Nova Normæ, on a plate taken at Arequipa on July 10, 1893, and examined by Mrs. Fleming on October 26 of the same year. Some of these discoveries were rather more belated; for example, Nova Persei (No. 1) "appeared" in 1887, but was not "discovered" until the plate was examined at Harvard in 1895.

Then, again, Mrs. Fleming's researches led her to the discovery of a great number of new variable stars, stars having peculiar spectra—such as those of the Wolf-Rayet type—and nebulæ. In a list of 108 nebulæ discovered at Harvard, and published in No. VI., vol. lx., of the "Annals," Mrs. Fleming was credited with fifty-two, discovered during the period 1888 to 1907. It was also her examination of the Harvard plates, in 1891, that revealed the duplicity of β Lyræ, which, up to that time, had remained an enigma, from the changes in its spectrum, to astronomers. Such discoveries as these, by Mrs. Fleming, have been a consistent feature of the Harvard "Circulars" for many years, and from Prof. Pickering's report for the year ending September 30, 1910, we learn that, during that year, Mrs. Fleming's keen examination revealed twenty-one new variable stars, one star of the fourth type, two of the fifth, four of the sixth, four gaseous nebulæ, and one star the spectrum of which appears to be unique. Not a bad haul of discoveries for one year!

Those who had the good fortune to come into personal contact with the deceased astronomer found her most unassuming in her manner, although fitted and ever-ready to give, from her wonderful store of knowledge, every assistance possible to anyone who desired information concerning the remarkable variations of stellar spectra. At Harvard, in America, in fact, throughout the whole astronomical world, her death will be felt as a great loss.

WILLIAM E. ROLSTON.

THE SCIENCE MUSEUM.

IN NATURE for May 4 we announced the publication of the report of the Departmental Committee on the Science Museum and the Geological Museum, and we gave some extracts from it. Since then "Further Correspondence and Memoranda" have been published (Cd. 5673), and besides this there have been many letters in *The Times* on the subject. These have come mainly from biologists, urging that any building erected as a science museum at South Kensington would ultimately interfere with the possibilities of the expansion of the Natural History Museum. As a counterblast to the memorial from representatives of the physical and mechanical sciences published in the report, there has been issued another from representatives of the biological science. As usual, the men of science are working against each other, a sorry spectacle which must greatly gratify those who are asked for money to help its progress.

It would appear also from an "Historical Memorandum," printed in the white paper referred to, and from a letter from Sir Norman Lockyer, which was printed in Tuesday's *Times*, that the authors of the correspondence to which reference has been made have not been too careful about their facts; the main facts are shortly stated in Sir Norman Lockyer's letter, which we reproduce, but even he does not tell us the whole story. When land was to be allocated to the Natural History Museum, 1863, two proposals were before the Government, according to Lord Palmerston, its spokesman (*Hansard*, June 15, 1863), schemes demanding three acres and eight acres respectively. Lord Palmerston compromised with five acres, about the same area on which it is now proposed to build the Science Museum.

To the Editor of THE TIMES.

SIR,

Some four years ago I considered it my duty to call the attention of the Royal Commission of the Exhibition of 1851 to the fact that practically the whole of the land belonging to them had been allocated, and that, so far, no proper provision had been made for a Museum doing for the Physical, Chemical, and Mechanical Sciences what the British Museum Library does for books, the Galleries for Antiquities, the National Gallery does for pictures, and the Natural History Museum does for the Biological Sciences.

As the action of the Royal Commission on my Memorandum has produced a situation which has given rise to some correspondence in *The Times*, I ask your permission to deal with the main question, which is being lost in the various side issues and details now being discussed.

In the original idea of the Prince Consort, by whom the purposes to be served by the Estate were laid down, a Science Museum was contemplated. The Commission sold their first plot of land west of Exhibition Road to the Government in 1863. Lord Palmerston, in introducing the Vote for this purchase, said in the House of Commons (*Hansard*, June 15, 1863):—

"Now, the question is, what do we want? What are the requirements that press on the Government? In the first place we want a Patent Museum." . . . "Then we want an addition to the British Museum." . . . Thereafter he referred to the need for a Portrait Gallery, now provided elsewhere.

The White Paper Cd. 5673 giving, at the instance of Lord Cromer, "Further Correspondence" on this subject, includes an historical memorandum which refers to leading points in the development of the ground. Some of these, however, may well be noted here.

In 1880 the building of the Natural History Museum was completed, and the land on which it was built was fenced off on the north side. The area then fenced in contained very nearly 11¾ acres, more than twice the land assigned to the Natural History Museum by Lord Palmerston. The building itself covered very nearly 3¾ acres, leaving 8 acres unoccupied. From that day to this, *i.e.* a period of thirty-one years, there has been very little reduction of this unused ground, sacred for all this time to nursemaids.

In 1874 the Duke of Devonshire's Royal Commission on Science urged the importance to the nation of the development of the Science Museum and of the organisation of a Solar Physics Observatory—both institutions in direct furtherance of Science and the Arts, the aim of the Commissioners in selling the land to the Government in 1863. The Government acted on both these recommendations. In 1876 a Loan Collection of Scientific Apparatus was organised, and the Office of Works gave permission for an Observatory to be erected on the ground.

In 1876 the success of the Loan Collection was so marked that the Royal Commission offered 100,000*l.* to commence the building of an adequate Science Museum. In 1888 the Government came into possession (with the regrettable exception of the N.W. corner) of the whole area of land between the Cromwell Road and Imperial Institute Road, nearly 21 acres (20·9).

This is now allocated as follows:—

	Acres
Natural History Museum and grounds, including private roadway between E. and W. boundaries, up to the original fence	11·64
Imperial College, Post Office, and Meteorological Office, and necessary open spaces	3·3
	14·94

Say 15 acres.

These 15 acres deducted from the 21 acres leaves 6 acres for the purposes of the Science Museum, roughly only 2 acres more than the area actually occupied by the Natural History Museum building.

Now to use even a part of this area for a Science Museum, which must eventually stretch right across the strip, the Spirit Museum, not necessarily the building, but its inflammable contents, must go. If there is any opprobrium attached to this suggestion, I am content that it should fall on my shoulders, for I was careful to point out this necessity in my Memorandum of 1907 written for the information of the Royal Commission, and I do not know that anyone had considered the question before that year. If there is any difficulty about placing the enlarged Spirit Museum along Queen's Gate, it can be built in two portions east and west of the entrance in Cromwell Road. The future extensions of the Museum might then be erected on the frontages to Queen's Gate and Exhibition Road.

It will be noticed that my figures give a little larger area for the Science Museum than those shown in the "Further Correspondence" (Cd. 5673); this arises from the fact that I not only take the original line of fence, but consider the already existing road to the north of the Natural History Museum is sufficient to serve the purposes of both Museums. If the two organisations work together, not only would space be thus saved, but the amenities of the gardens, until they are built over, would be made common to both Museums.

I now come to the real question at issue in which the Nation is chiefly interested. Now that we have an Imperial College responsible for the highest teaching, both in the Physical and Biological Sciences, represented by the two Museums, it is clear that the highest efficiency of the teaching, if Museums are worth anything, will be secured by all three institutions being as close together as possible.

There would then be a grave objection to one of the courses recommended by one of your biological correspondents, namely, that the whole of the remaining 6 acres should be added to the Natural History domain, making in all nearly 17 acres, of which at present they use about 4, while the Museum dealing with all the other branches of Science should go elsewhere.

It must not be forgotten, too, that the munificent offer of the Royal Commission of 100,000*l.*, now made for the third time, towards the building of the Science Museum has been made on the understanding that the Museum was to be built on land conveyed to the Government by them in accordance with the Prince Consort's views that the National Collections of all kinds should be housed on it.

The Science Museum must then take its place by the side of the Natural History Museum on the South Kensington site. What is it to include? What is likely to be its rate of expansion? It should include all the products of men's ingenuity in science, both pure and applied; it should form the base of the discoveries and the applications of the future in all scientific directions. It should be to the worker in science what the British Museum Library is to the student in literature—a stepping-stone to higher things.

As we have in it to deal with the works of man, and over an enormous field, the new Science Museum should from the start increase rapidly year by year, while the Natural History Museum, dealing with the works of nature, is already an old institution, and has largely completed its general collections. Nature's new species, representing animal advance, are not produced at the rate at which, at this moment, man's new species, representing intellectual and material advance, come into being.

An area, therefore, for the Science Museum about the same as that thought necessary for the Natural History Museum by Lord Palmerston when the land was purchased, an area, indeed, not yet occupied by the buildings for that Museum, should not be considered excessive for the Science Museum. Moreover, it is certain, when space is available, to increase more rapidly than the Natural History Museum, and it will be pinched for space before two generations are out unless the design for the Museum building is prepared on a scheme that will take full advantage of modern methods of construction with the possibility of several superimposed stories of Exhibition Galleries readily accessible by lifts. The frontage Galleries of the adjoining Art Museum show how much can be done in this way.

This being so, is it just and decorous for representatives of the biological societies to claim more space when they already have more than they will require during the next century, judging by the rate of expansion during the last thirty years?

At the same time, it is not to be denied that recent investigations have opened out new inquiries of a most important and far-reaching character. And what has happened in the past may occur again in the future. Ample space must be forthcoming to provide for all such contingencies.

This does not necessarily suppose great expansion of exhibition space; but it may do so, and it will assuredly require the provision of adequate accommodation for investigation of the collections now existing or to be formed.

With regard to extensions of the two Museums in the distant future there is no difficulty. There is a block of houses and mews covering roughly 6 acres to the west of Queen's Gate, and opposite the 21 acres of Government ground. The ultimate purchase of this would allow of the two frontages being continued. It is fair to leave to a future generation the question of such an extension, for we cannot forecast the nature of the demands which may then be made for further Museum accommodation.

Has not the moment at last come when all those interested in science in its various aspects should co-operate to find the solution of a question which has been debated for a generation? There should be no contention between these persons—their aims are the same; they desire to afford the best facilities for the increase and coordination of knowledge in all its branches. In my opinion it can be shown that all this can be accomplished at South Kensington, and a really splendid monument can be provided. Is this the moment for contention as to whether this or that branch has a big enough show? Ought we not rather to come together and see how best to utilise what we have got?

(*Signed*) NORMAN LOCKYER.

NOTES.

THE Faraday lecture of the Chemical Society will be delivered by Prof. T. W. Richards, of Harvard University, on Wednesday, June 14, in the theatre of the Royal Institution.

THERE will be a display of calculating machines on Tuesday, June 13, at the Royal Statistical Society's house, 9 Adelphi Terrace, W.C., from 4 to 5.30, during an at home, for which invitations have been issued.

THE second Biennial Congress of the Far Eastern Association of Tropical Medicine is to be held in Hong Kong from January 20 to 27, 1912. The association is international, and, as the title denotes, was formed to promote the study of tropical medicine in the Far East.

THE death is announced of Prof. Samuel Calvan, professor of geology in the State University of Iowa, and State geologist of Iowa. Prof. Calvan was seventy-one years of age, and had been connected with the University of Iowa for thirty-seven years.

At the annual general meeting of the Institution of Electrical Engineers, held on Friday last, Mr. S. Z. de Ferranti was elected president, and Mr. W. Duddell, F.R.S., Major W. A. J. O'Meara, C.M.G., Mr. W. H. Patchell, and Mr. J. F. C. Snell vice-presidents, for the session 1911–12.

A festival in memory of Richard Jefferies is to be held at Swindon on Saturday, June 10. Jefferies was born at Coate, near Swindon, and spent his early life in the latter place. It is proposed to pay a visit to Coate Farm, the naturalist's birthplace, and an open-air concert, morris dancing, speeches, and a short service in Chiseldon Church have been arranged for.

The sum of 1000*l.* has been placed at the disposal of the Home Secretary by a colliery proprietor to form a prize for the best and safest electric lamp for use in mines, and Messrs. C. Rhodes and C. H. Merz have consented to act as judges upon the lamps submitted. The competing lamps must be addressed: care of Mr. C. Rhodes at the Home Office Testing Station, Rotherham, and must be delivered by, at latest, December 31 next.

An appeal is being made to all who are interested in photography, or in the history, archæology, and science of Kent, to become members and correspondents of the Photographic Record and Survey of the county, and to contribute, if possible, half-a-dozen prints each year to the collection in the County Museum of Maidstone. At the recent annual general meeting Sir David Salmons, Bart., was re-elected president, and the secretary reported that 553 prints had been added to the survey collection during the year. Prospectuses of the survey and any information relating to it will be gladly supplied by the secretary, Mr. H. E. Turner, 14 Queen's Road, Tunbridge Wells.

At the anniversary meeting of the Linnean Society, held on May 24, the following officers and council were elected for the ensuing year:—*President,* Dr. D. H. Scott, F.R.S.; *treasurer,* Mr. H. W. Monckton; *secretaries,* Dr. B. Daydon Jackson, Prof. A. Dendy, F.R.S., and Dr. Otto Stapf, F.R.S.; *council,* Prof. V. H. Blackman, Mr. H. Bury, Sir Frank Crisp, Prof. A. Dendy, F.R.S., Prof. J. Stanley Gardiner, F.R.S., Mr. E. S. Goodrich, F.R.S., Mr. H. Groves, Prof. W. A. Herdman, F.R.S., Mr. A. W. Hill, Dr. B. Daydon Jackson, Mr. H. W. Monckton, Prof. F. W. Oliver, F.R.S., Prof. E. B. Poulton, F.R.S., Dr. A. B. Rendle, F.R.S., Dr. W. G. Ridewood, Miss Edith R. Saunders, Dr. D. H. Scott, F.R.S., Dr. Otto Stapf, F.R.S., Miss E. N. Thomas, and Dr. A. Smith Woodward, F.R.S.

At the anniversary meeting of the Royal Geographical Society, the Founder's medal was awarded to Colonel P. K. Kozloff for his explorations in Central Asia since 1883, and the Patron's medal to Dr. J. B. Charcot for his expeditions to the Antarctic continent. The Victoria research medal was awarded to Captain H. G. Lyons, F.R.S., for his work on the Nile Basin and the topographical, cadastral, and geological surveys in Egypt, which he directed when Director-General. Other awards were made to Dr. Wilfred Grenfell, of Labrador, Captain G. E. Leachman for work in Arabia, Dr. Arthur Neve for his investigations in the Himalayas, and to Mr. R. L. Reid for his surveys of the Aruwiari River.

The anniversary dinner of the Royal Geographical Society was held on May 26 at the Hotel Cecil, when Lord Curzon, the president of the society, reviewed the many striking events of geographical importance which had occurred during his predecessor's tenure of office. He alluded to the very inadequate accommodation which the society possessed at the present time, and urged that, in the interest of the scientific development of the subject in this country, better and more commodious premises were urgently needed. Twenty-two past and present medallists of the society were present, and Sir John Forrest, who was honoured by the society as early as 1870, and Dr. Charcot, one of the medallists of this year, responded on their behalf.

The *Terra Nova*, the vessel which conveyed Captain Scott and his expedition to their base of operations, has now been overhauled and chartered by the New Zealand Government for surveying work. Sailing from Christchurch in July, work will be carried out on the northern coast of North Island, and then between the northern coast and the small islands of Manawa Tawhi. The delimitation of the 100-fathom lines and shoal soundings are to be undertaken which should lead to results of much practical importance. The Central News further reports that Mr. D. G. Lillie, a biologist of the Antarctic expedition, has, in sorting and preserving specimens for transmission to Europe for study by specialists, recognised that the collection contains a number of species of invertebrates hitherto unknown.

Prof. W. L. Grant, professor of colonial history at Queen's University, Kingston, Canada, lectured before the Royal Geographical Society on Monday last on the geographical conditions affecting Canada. After alluding to the physical character of the country, the lecturer pointed out the immense resources, agricultural, mineral, and climatic, which must inevitably give Canada before many decades a dominant position in the Empire. Much remains to be done, but the large ideas of early pioneers have been fully justified, and bold schemes for the further development of the country are being confidently put forward. Still, there is great need of an adequate inventory of the Dominion's resources, which, though vast and imperfectly known, are of the greatest value, and any squandering of them needs carefully to be guarded against.

The Research Committee of the National Geographic Society of Washington, it is reported in *Science*, has made a grant of 1000*l.* for continuing the glacier studies of the two previous years in Alaska. The work, beginning in June next, will be done by Prof. R. S. Tarr, of Cornell University, and Prof. Lawrence Martin, of the University of Wisconsin, who have directed the National Geographic Society's Alaskan expeditions of 1909 and 1910 in the Yakutat Bay, Prince William Sound, and lower Copper River regions. This year's expedition will study briefly a number of regions of glaciers not previously investigated by the National Geographic Society, although partially mapped by the Alaska Division of the U.S. Geological Survey. Work will be done on the present ice tongues and the results of glaciation in the mountains and plateaus of parts of the interior and some of the fiords of south-eastern Alaska, the former having lighter rainfall and smaller ice tongues than the Yakutat Bay and Prince William Sound regions.

In a paper read at the Buxton meeting of the Association of Water Engineers on May 20, on the water supplies of the river basins of England and Wales, Mr. W. R. Baldwin-Wiseman, of Southampton, directed attention to the lack of proper coordination and control in the administration of the fresh-water resources of this country. He pointed out the pressing need for river boards, which,

while thoroughly representative of local interests, would subordinate their functions to the general direction of a national hydrographical department, and he considered that this body should be represented in Parliament by a Minister of Water Supply. It is certainly true that, compared with the highly efficient hydrological organisations existing in France, Italy, and the United States, the efforts of similar bodies in Great Britain are local and sporadic, and this lack of interdependence and control is conducive neither to a satisfactory conservation of our resources nor to their effective development. Mr. Baldwin-Wiseman has also dealt with the matter in a paper on the administrative aspect of water conservancy, read before the Society of Engineers in April last. Both papers are timely, for the problem is one which must inevitably be faced and solved at no distant date.

AT the last scientific meeting of the Zoological Society Dr. C. W. Andrews, F.R.S., gave an account of some fossil mammalian remains lately received at the British Museum (Natural History) from British Central Africa. The specimens, which were collected on the eastern side of Lake Victoria Nyanza, were sent to the museum by Mr. C. W. Hobley, C.M.G., Commissioner of Mines for the district. For the most part only fragments of bones are preserved, but in addition to these there is a portion of a mandible of a small species of Dinotherium with several well-preserved teeth, so that there is no doubt as to the genus. The species seems to be very closely similar to *Dinotherium cuvieri* from the Lower and Middle Miocene of France, and it may be that the beds from which the African species is derived are of the same age; but, on the other hand, it is also possible that Dinotherium survived in Central Africa long after it became extinct elsewhere, in which case the deposits may be of a later date. The interest of this discovery is that it is the first record of the existence of Tertiary mammals in Central Africa, and that when the age and relationship of the beds in which they occur are known, much light may be thrown on the geological history of the African lakes. In the same beds occur fragments of a small rhinoceros, a giant land-tortoise, Trionyx, and crocodile. The excellent condition in which the bones are preserved gives great hope that careful collections will lead to the discovery of new forms which will clear up many obscure points on the history of the Mammalia.

THE summer meeting of the Concrete Institute will be held in the Lecture Hall, Denison House, Vauxhall Bridge Road, on June 7 and 8, when the following papers will be read and discussed:—The æsthetic treatment of concrete, by Prof. Beresford Pite, after which an interim report of the Tests Standing Committee on the testing of concrete, reinforced concrete, and materials employed therein will be presented, and the Y.M.C.A. building, Manchester, by Mr. A. E. Corbett, to be followed by the presentation of a report of the Reinforced Concrete Practice Standing Committee on the standardisation of drawings of reinforced concrete work. The first annual dinner of the institute will take place in the evening of June 7, and in the evening of the following day there will be a conversazione in the galleries of the Royal Institute of British Architects.

THE programme of the jubilee meeting of the Institution of Naval Architects (which, as already announced, is to take place on July 5, 6, and 7) has just been issued. We learn from *Engineering* that among the papers to be presented are the following:—Warship building, by Sir P. Watts; naval engineering, by Engineer-Vice-Admiral Sir H. Oram; naval artillery, by Sir A. Noble; mercantile shipbuilding, by Dr. S. J. P. Thearle; steam turbines, by the Hon. C. A. Parsons; armour, by Mr. C. E. Ellis; fifty years' architectural expression of tactical ideas, by Admiral Sir C. Bridge; the history of the institution and the progress of scientific education in naval architecture, by Sir W. White; some further notes on cavitation, by Mr. S. Barnaby; naval construction, by Rear-Admiral Kondo; naval engineering, by Engineer-Rear-Admiral Fujii; mercantile shipbuilding, by Mr. Yukawa and Dr. Terano; and a paper on the service performance of two Japanese turbine-driven ships. A paper on passenger steamboat construction will be read by Mr. F. E. Kirby, and one on the results of tests on models of submarines by Mr. M. F. Chace. Prof. Rateau will deal with the rational application of the turbine to ship propulsion, and Prof. Marbec with the collapsing of beams and elastic curve slips. Dr. O. Schlick will treat of the present knowledge of the vibration phenomena of steamers, and Prof. O. Flamm will deal with the scientific study of naval architecture in Germany. Lieut.-Colonel G. Russo will review progress in shipbuilding in Italy, and Mr. J. Johnson that of recent developments in the transportation of ore.

MR. R. D. BANERJEA, of the Indian Archæological Department, announces the discovery at Dacca, on a temple image of the terrible goddess Chandi, consort of Siva, an inscription of the reign of Lakshmana Sena Deva, King of Bengal, dated 1122 A.D. This is the first inscription of the kind from eastern Bengal proper which gives the date of a king of Bengal. He is said to have reigned over a tract of country extending from Benares to the Garo Hills, and from the Himalayas to the sea. The result of this discovery is that, in the light of the fresh information which it supplies, the greater portion of the ancient history of the Province of Bengal must be re-written.

IT has repeatedly been stated that the effects of a tropical sun in inducing sunstroke, &c., are due more to the chemical than to the heat rays, and therefore clothing lined with or made of a fabric of material which does not transmit the chemical rays has been recommended for wear in tropical climates. An experiment with orange-red underwear has been tried in the Philippines, and is recorded by Captain Phalen, of the U.S. Army. No beneficial effect whatever was observed from the use of this clothing; on the contrary, it added to the burden of heat upon the system, and it is concluded that white or khaki clothing sufficiently excludes the chemical rays (*Philippine Journal of Science*, v., No. 6, 1910, p. 525).

IN the report of the Zoological Society of Philadelphia for the past year stress is laid on two factors in regard to the well-being of animals in captivity, namely, the importance of *post mortem* parasitical investigations and the success of the outdoor treatment. Even the loss of the tips of their tails through frost-bite by a pair of hamadryad baboons is considered no bar to the continuance of the "simple life" method.

MR. C. FORSTER-COOPER, who recently made an expedition to the Bugti Hills of Baluchistan for the purpose of collecting fossil mammals, has returned to this country. A considerable series of fossils are, we understand, on their way home, and will eventually be added to the collections of the British Museum. The first mammalian fossils from the Bugti Hills were collected by the late Dr. Blanford and described by Mr. Lydekker; they indicate a lower

horizon than the typical Siwalik fauna. A number of new types have recently been described by Mr. Guy Pilgrim.

FROM a report contributed by Dr. F. A. Jentink to Nos. 2 and 3 of vol. xxxiii. of Notes from the Leyden Museum, it appears that the recent Dutch expedition to the Snow Mountains of New Guinea did not obtain anything very striking in the way of mammals. In fact, the only novelties are three species of pouched mice of the genus Phasgologale, one of which is the largest, and a second the smallest, of the Papuan representatives of the group. A lower jaw of a peculiar rat, *Anisomys indicator*, hitherto known only by a couple of specimens and characterised by the extreme narrowness of the lower incisors, was, however, obtained from the natives.

WE have been favoured with a copy of a pamphlet, by Prof. Berthold Hatschek, of Vienna (published by W. Engelmann, of Leipzig), entitled "Das Neue Zoologische System." In this scheme, which is the last of several already prepared by the same author, the animal kingdom is divided into the two sections Protozoa and Metazoa, and the latter again subdivided into three main groups, namely, Cœlenterata (including sponges), Ecterocœlia, and Enterocœlia, the last comprising Chætognatha, Echinodermata, Brachiopoda, Enteropneusta, Tunicata, and Vertebrata, while the second group embraces all other metazoan invertebrates except cœlenterates. The Cœlenterata are regarded as the direct descendants of the Protozoa; but the chief novelty claimed for the scheme is the independent derivation of the two main groups of Cœlosomata, that is to say, the Ecterocœlia and Enterocœlia, from distinct groups of Cœlenterata.

THE May number of *The Zoologist* contains an account of a new earthworm or treeworm recently discovered by the Rev. Hilderic Friend. It is named *Dendrobaena merciensis*, Friend, because it was found near the old capital of Mercia. At first sight it resembles *D. beddardi* and *Bimastus eiseni*, but it differs from these in the fact that the girdle extends from the twenty-second to the thirty-first segment. It is destitute of tubercula pubertatis. In the same journal we have a continuation of the same author's studies in the distribution of British annelids, in which the county records are set forth alphabetically. There are no records known to the author for Bedford, Berkshire, or Cheshire, but we find Bucks credited with eleven species of earthworm, Cambridge sixteen, the Channel Islands and Cornwall twelve, Cumberland seventeen, and Derbyshire sixteen. The total number of known British species has now been raised by Mr. Friend to forty.

IN Heft 4 of the *Zeitschrift der Gesellschaft für Erdkunde* Dr. A. Grund describes the hydrographical results of the first cruise of the steamship *Najade*, which has been detailed by the Austrian Government for the oceanographic investigation of the Adriatic by Austrian and Italian specialists. Four sections were sounded from east to west, while others were at the same time being executed by the Italian surveying ship *Ciclope*. Temperature, density, and salinity of the water were also studied, though the "Bora" blowing down the gulf hindered the work at times.

IN Erganzungsheft No. 4 of the *Mitteilungen aus den Deutschen Schutzgebieten* Dr. F. Jaeger gives the result of a very thorough exploration carried out in 1906 and 1907 in the southern portion of the Eastern Rift Valley, to the south-west of Kilimanjaro, and to the south-east of Lake Victoria. As careful a survey was made of the region as time would allow, and accurate triangulation was utilised to control the topographical work. A large collection of geological specimens was made, and these are described in the present memoir, but no general account of the structure of the district is given. The form of the ground traversed is indicated by form-lines on two maps of large scale (1 : 150,000), but is not described in the text. A vast crater basin with many minor vents occupies the northern portion near Lake Njarasa (Eyassi), and many points rise to more than 3000 metres. The whole area is immature in its topography, the drainage lines being short and steep, leading to the floors of the fault valleys in which the lakes are situated. The southern portion shows more clearly a series of parallel fault-blocks striking N.E., with lakes or marshes occupying the low-lying ground between. The meteorological observations have not been printed, but have been autographed and deposited at various institutions in Germany. As a study of earth forms, the maps are highly instructive.

THE report of the Botanical Club of Canada for 1909, issued by the secretary, Dr. A. H. Mackay, contains the announcement that the club has been dissolved, and that the work of collecting and tabulating phenological observations in the Dominion, formerly undertaken by the club, has been transferred to the officials of the Meteorological Service.

A SHORT paper contributed by Dr. Wm. Trelease to the Transactions of the Academy of Science of St. Louis (vol. xviii., No. 3) deals with the species of Agave cultivated during recent years in Mexico under the name of "zapupe." Of the various forms for which numerous local popular names exist, five different species, all new to science, are delimited according to spine characters, and these fall into three groups. They may be distinguished as "azul," "Tepezintla," "ixtle," "cimarrón," and green zapupe, and are probably all referable to the section Euagave; as cultivated plants they rarely set capsules, and appear to be freely bulbiferous after flowering.

IN the absence of definite criteria, the phylogeny of the algæ provides scope for varying opinions and hypotheses. Thus in the *Biologisches Centralblatt* (April 15) Mr. J. Brunnthaler elaborates the view that the red algæ are the most primitive. A primary reason is supplied by the argument that in early times the earth was surrounded by a dense vapour through which the sun penetrated with difficulty, and therefore the conditions of diffused light which prevailed were similar to those under which most red algæ now live. The origin of the group is referred to primitive ancestors of the Flagellatæ. Next in sequence are placed the brown algæ, derived partly from red forms and partly from the Flagellatæ, while the youngest line of development is assigned to the green algæ.

THE cold days of May were rather late in their occurrence this year, but were experienced towards the close of the period shown by the average results for a series of years. This year, May 19, 20, and 21 were the only really cold days, the maximum temperature for the period at Greenwich being 56·5°, and on May 20 the highest temperature was 52·3°. Last year the cold days in May fell fully ten days earlier, and in 1909 a week earlier. A brisk northerly wind was blowing this year, and an anticyclone was situated in the Atlantic in close proximity to our coasts. A change to warmer weather set in on May 22, when at Greenwich the shade temperature ranged from 35° in the early morning to 70° at midday. The summary of the weather for the week ending May 20, issued by the Meteorological Office, shows that the mean temperature

for the week was above the average over the whole area of the British Islands, the greatest excess being 3·6° in the Midland counties, and the least 1·1° in the north of Scotland. The absolute temperature ranged from 73° in the east of England to 33° in the east of Scotland.

A NEW edition (the seventh) of the handy "Hints to Meteorological Observers," prepared under the direction of the Council of the Royal Meteorological Society by Mr. W. Marriott, has been received. The present edition has been revised and enlarged; the explanations and illustrations of ordinary and self-recording instruments are very satisfactory. We are glad to find a considerable addition to the very useful glossary of meteorological terms, including those most recently introduced. We think this might be still further improved by more additions, and occasionally by a little fuller explanation. We notice here and there a slight departure from the explanations usually given, *e.g.* the order of the colours of the corona. We can only repeat the opinion before expressed, that the work takes a high place among the best of such handbooks published in any country.

AN interesting article on the weather in the seventeenth century, by Mr. W. Sedgwick, is published in *Symons's Meteorological Magazine* for May, containing extracts relating to the spring (March–May) between 1658 and 1705 from the diaries of John Evelyn, F.R.S., and Samuel Pepys, F.R.S. The author proposes in this and subsequent numbers to give an opportunity of considering whether these extracts show that any marked change in the climate of London has occurred since that period. Statements are often made that our climate has undergone considerable changes in comparatively modern times. On the other hand, well-known investigators of the present day have shown that any apparent changes either in temperature or rainfall can be accounted for by the difference in the instruments and their exposure. Although these instruments were known before the close of the seventeenth century, there were but few in existence; they cannot have been used regularly, if at all, by Evelyn or Pepys, and the tendency in the case of non-instrumental observations would be to record abnormal rather than normal conditions. Another important consideration pointed out by the author is the change from the Julian to the Gregorian Calendar, which was made in England in 1752. With reference to the popular belief about the old-fashioned Christmas, in several years during the last decade there have been considerable falls of snow after Christmas which would have occurred before Christmas if the Julian Calendar had been still in force.

THE Journal of the Royal Statistical Society for May contains an important paper, by Mr. E. C. Snow, on a new method of estimating post-censal populations, *i.e.* the populations of different districts of a country in the years following a census. The estimation of such populations often offers considerable difficulties, especially in districts of a rapidly changing character in the neighbourhood of large towns, and the method at present in official use—based on the assumption of the approximate maintenance of the rate of change during the preceding intercensal decade—may lead to very serious errors. For example, the birth- and death-rates in Salford in 1890, based on the estimated population, were calculated at 28·8 and 22·4 respectively, but when the results of the census taken in the following year were made known, these figures were altered to 35·6 and 27·6. Mr. Snow suggests that definite indices of a change of population, such as changes in the number of births, deaths, marriages, or houses, should be used as the basis of the estimate, that regression equations should be formed by the method of correlation between the change in population of a district and the changes in these several indices during a completed intercensal decade, and that these regression equations should be applied to the following decade. Trial of the method on several groups of districts of diverse characters showed that it would lead to greatly increased accuracy.

INVESTIGATIONS of the hitherto almost unknown ultraviolet spectrum—the Schumann region—are of special interest, because the conditions attending the production of these extremely short wave-length radiations are obviously of a different character from those attending the production of the more familiar spectrum. In this research Mr. Theodore Lyman has taken a great part, and in the March number of *The Astrophysical Journal* (vol. xxxiii., No. 2, p. 98) he publishes results obtained from an investigation of the nature of the radiation from oxygen, hydrogen, nitrogen, helium, and argon in the region more refrangible than λ 1900. No lines of helium and oxygen have yet been discovered in this region; if they exist they are too faint to be disclosed by the present methods. By varying the conditions of discharge in the vacuum tube, two spectra of nitrogen were revealed, one of faint bands with heads on the more refrangible edges, the other consisting of two pairs of sharp lines at $\lambda\lambda$ 1492·8, 1494·8, 1742·7, and 1745·3. No lines were seen in the "red spectrum" of argon, but a considerable number, about forty between λ 1333·7 and λ 1886·1, exist in the "blue spectrum." Repeating the experiments made by Schumann, Mr. Lyman has, as yet, been unable to obtain the primary spectrum of hydrogen which Schumann suspected. An interesting spectrum, apparently intimately associated with hydrogen, appears in the region λ 1650–λ 1450, and consists of five groups, each group containing five lines. Argon containing a trace of hydrogen at a pressure of 2 or 3 mm. shows this spectrum well if aluminium electrodes and no capacity are employed. Nitrogen, oxygen, and helium containing a trace of hydrogen do not show the groups, and if other electrodes are used considerable enfeeblement occurs. With pure hydrogen these groups always appear—with the other lines—and they disappear if the last trace of hydrogen is removed from the argon mixture. If their origin is an impurity in the hydrogen, it must be of a fundamental character, for the groups appear in all the hydrogen used by Lyman and by Schumann for many years; they may be a new spectrum of hydrogen. For a description of the apparatus and methods employed in the research the reader is referred to the original paper.

THE April number of *Le Radium* contains a memoir by M. L. Dunoyer, of the laboratory of Madame Curie, on the production of a material radiation of purely thermal origin. A tube of hard glass about a centimetre in diameter and about 30 centimetres long is joined at its upper end to a wider tube, the length of which varies from 2 to 13 centimetres in different cases. A side tube leads from the enlarged head to a Gaede pump. The lower end of the tube is covered inside with a film of metallic sodium obtained by distillation *in vacuo* from a heated tube originally communicating with the experimental tube, but sealed off when the deposit has been formed. When the lower part of the tube is now heated, so as to vaporise the sodium and drive it into the upper part of the tube, it is found that if diaphragms with small openings of the order 2 or 3 millimetres diameter are placed in the tube above the sodium deposit, the molecules of vapour are driven through the openings with such velocity that they form a

deposit on the end of the enlarged part of the tube which reproduces the shape of the opening of the last diaphragm through which the vapour has passed. If a plate with holes of any form in it is interposed in the path of the molecules, the deposit on the end of the tube reproduces the openings sharply. M. Dunoyer is already engaged in experiments to determine the kinetic energy of the projected molecules or particles and to measure their electric charge, if any.

Red Book No. 155 of the British Fire Prevention Committee deals with the loss of life at the Asch Building fire in New York on March 25. It will be remembered that there were 145 deaths. The committee has procured a trustworthy report from Prof. Ira Woolson, of New York; this report was originally prepared by Mr. F. J. T. Stewart, superintendent of the New York Board of Underwriters. This great loss of life occurred where the structural damage was relatively small, and practically affected only the fitments and equipment of the three top stories of the building. Bad planning and exit facilities, neglect of the ordinary precautions to prevent an outbreak of fire, the absence of any prearranged system of utilising the existing appliances, together with neglect to have all routes of exits clear for easy and immediate use, are the primary causes of the catastrophe. The building comprised a sub-basement, basement, ground floor, and nine floor levels; its height may have some bearing on the total number of lives lost, but scarcely on the general extent and character of the calamity.

WE have received a pamphlet from Mr. Wm. Love, of 42 Claremont Square, London, N., giving particulars of his system of maintaining straight the rolls used for rolling flat sheets. The method appears to be novel, and consists in supporting the rolls by means of intermediate bearings. These bearings are in turn supported by means of beams, so arranged that the deflections of all the bearings under a uniform load on the roller are equal; hence the roller remains practically straight. There are no supports at the ends of the roller. Suppose, for example, that four intermediate bearings are fitted. The roller is divided into four imaginary equal segments, and each bearing is at the centre of a segment. The four bearings are supported on a beam, which we may imagine to be divided into two equal segments. This beam is supported at two points, one at the middle of each segment, and the supports are formed symmetrically on a longer beam, which is in turn supported at its ends. On the latter beam deflecting under the load, the two points at which the first beam is supported will suffer equal deflections, and by the arrangement of bearings on the first beam, all these bearings will deflect equally. In this system the roller may be much less in diameter than has been customary, as reliance on its stiffness is unnecessary. For example, a roller 2 inches diameter by 24 inches long, supported in the ordinary way, would deflect, say, 0·1 inch; supported on Love's system, the deflection for the same load is 1/2560 inch. Other applications of the principle are given in the pamphlet.

MESSRS. MACMILLAN AND CO., LTD., announce for early publication the third English edition of Prof. W. Nernst's "Theoretical Chemistry," corresponding to the sixth German edition, and translated by Mr. H. T. Tizard, Magdalen College, Oxford. The portion of the book dealing with thermodynamics has been largely rewritten and includes a detailed account of the author's new theorem of thermodynamics. A chapter on radio-activity has also been added. The text of the earlier English edition has been completely revised and partly rewritten. The translator has also made some additions to the text, at the suggestion of Prof. Nernst, in order to bring the book up to as late a date as possible. These include an account of Nernst's work on specific heats at low temperature, and a short summary of Perrin's recent researches on Brownian movements.

MESSRS. E. AND F. N. SPON, LTD., announce for early publication "Bibliographical History of Electricity and Magnetism Chronologically Arranged," by P. F. Mottelay.

OUR ASTRONOMICAL COLUMN.

METCALF'S COMET, 1910*b*.—An observation of Metcalf's comet was made by Dr. Schiller at the Bothkamp Observatory on April 18, and showed that the comet still has a sharply defined stellar nucleus of magnitude 13·5. The total brightness was about equivalent to that of a star of magnitude 12·8, and when thin clouds obscured the comet the nucleus could still be seen. Dr. Ebell continues his ephemeris up to the end of July, when the estimated magnitude will be 14·8. The present position of the comet is two or three degrees north of κ and ι Ursæ Majoris (*Astronomische Nachrichten*, No. 4495).

RECENT OBSERVATIONS OF HALLEY'S COMET.—Prof. Barnard secured good observations of Halley's comet on April 16, 23, and 25, but finds that the object is rapidly growing fainter. On April 23, in a very good sky, the magnitude was estimated to be 14·5 or 15·0, but on April 25, with the sky not quite so good, it was estimated to be 15 or 16. Prof. Barnard states that the brightness has been subject to considerable fluctuations, and at the time of the second observation was probably in one of its fainter phases (*Astronomische Nachrichten*, No. 4500).

EARLY VISIBILITY OF THE NEW MOON.—Mr. Horner's observation of the new moon is discussed by Mr. Whitmell in No. 435 of *The Observatory* (May, p. 203). It appears that the observation was made when the moon was but sixteen, not seventeen, hours' old, which, so far as is known, constitutes a record; the moon was "new" at 1h. 13m. on the morning of February 10, 1910, and was seen by Mr. Horner, whilst looking for comet 1910*a*, at 5h. 13m. the same evening. The difference in azimuth between the sun and moon was roughly 10°, and, according to a paper which Mr. Fotheringham published in the Monthly Notices (R.A.S.) for May, 1910, the moon should be unobservable if its altitude were lower than 11°; but when Mr. Horner saw it the moon had an altitude of only 4° or 5°.

LARGE PROPER MOTION OF A SMALL STAR.—The examination of plates taken in 1892 and 1906 led Prof. Max Wolf to the conclusion that a 9·7 mag. star in Leo had an extraordinary proper motion. This was confirmed by Prof. Burnham, who has since kept the star under observation, and, from measures made during the period 1907–11, together with the 1892 photograph, finds that the most probable value for the proper motion is 1·228″ in 190·4°. The star's position (1900) is R.A. = 11h. 23m. 20s., dec. = +8° 6′ 1″, and it is 70s. preceding, and 185″ north of, the 7·5 magnitude star B.D. +8°2512 (Monthly Notices (R.A.S.), vol. lxxi., No. 6, April).

PHOTOGRAPHIC DETERMINATIONS OF STELLAR PARALLAX.—Having described the methods of photographically determining stellar parallaxes with the Yerkes 40-inch refractor, Dr. Schlesinger is now discussing the results in his series of papers appearing in *The Astrophysical Journal*. In papers iii. and iv. of the series (*The Astrophysical Journal*, vol. xxxiii., Nos. 2 and 3) he gives the results for fourteen stars, and in four cases finds positive parallaxes exceeding 0·1″. These are Groombridge 34, $\pi = +0·266'' \pm 0·010''$; μ Cassiopeiæ, $\pi = 0·105'' \pm 0·010''$; Weisse I., 5h. 592, $\pi = +0·189'' \pm 0·010''$; and Fedorenko 1457–8, $\pi = +0·148'' \pm 0·015''$. The last-named is a well-known double star (Σ 1321), which has a proper motion of 1·7″ per annum, and Dr. Schlesinger gives an interesting discussion concerning the probable source of a systematic error which appears, including therein a discussion of the effect of atmospheric dispersion on the measured images of the stars.

The parallax of π^4 Orionis is found to be $+0.012'' \pm 0.007''$, and in the cases of ψ Orionis and S Monocerotis negative parallaxes result from the measures.

THE PARIS OBSERVATORY.—M. Baillaud's report for the year 1910 contains a record of a great deal of work successfully accomplished, and, besides, gives interesting accounts of several ingenious instrumental devices. The ordinary astronomical work was carried on as usual, but, together with the observations of Halley's comet and other special observations, was greatly interfered with by the unfavourable skies at Paris.

The distribution of time signals by radio-telegraphy took place regularly after May 23, 1910, and on November 23, and subsequently, a signal was sent at 11 a.m., as well as at midnight as previously. A brief account of the installation for this purpose is given.

THE LONGITUDE OF THE RED SPOT ON JUPITER.—In a communication to the *Astronomische Nachrichten* (No. 4498), the Rev. T. E. R. Phillips records his observations of the Red Spot on Jupiter during the present apparition. These show the remarkable fact that the longitude of this feature has diminished by approximately 30° in the unprecedentedly short time of ten months. While in June last year the zero meridian of system ii. practically bisected the hollow, the longitude on April 13 and 16 was but slightly more than 330°.

MEASURES OF DOUBLE STARS.—Lick Observatory Bulletin No. 190 contains the measures of 159 double stars made by Mr. C. P. Olivier. The paper is the fifth of a series on double stars lying south of the equator, and sixty-one of the present objects are south of −30° declination; twenty-four new pairs are included. The bulletin also contains a table displaying Mr. Olivier's personal equation with respect to Messrs. Aitken and Hussey.

THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

TO continue the hospitality which had been showered on us, Mr. Mills placed a large customs steam launch at our disposal, and the same afternoon took us for an impromptu cruise about the beautiful harbour, Mr. Hedley, the assistant curator of the Sydney Museum, accompanying us. Unfortunately, however, at about 4.30, while steaming up Middle Harbour, we piled up on a sandbank on a falling tide, and it was not until 7.30 that we were able to float off. As we did not arrive back to the hotel until 9 o'clock, our trip to the capital site had to be postponed until next morning. Mr. Hunt had already sent numerous telegrams and secured tickets and sleeping accommodation in the train, but these were generously replaced by others available for the following day. The next morning (March 21) Mr. Hunt showed me the screens on the wall of the Sydney Post Office, in which were exposed the meteorological forecasts. These seemed to be very popular, judging by the number of people I saw closely examining them whenever I passed by. Then he showed me the meteorological department at the observatory. The view from the tower of this observatory is magnificent, and as I had my panoramic camera with me I took views all round. From an astronomical point of view the observatory is very hampered, for on three sides it is surrounded by closely packed buildings, rendering the atmosphere very smoke-laden. The afternoon was spent in motoring in the vicinity of Sydney, and very fine views of the country were obtained. In the evening Mr. Hunt and I left for the capital site. To reach this region we had to make a night railway journey, arriving at Queanbeyan at 4.30 a.m. At the hotel there we turned in until 8 o'clock, and then started away in a two-horsed vehicle for the surveying camp, which is situated on the site of the future capital. This meant a drive of eight miles over a somewhat rough road, but this road is in progress of betterment every day. At this camp we were received by Mr. C. R. Scribner, the chief Commonwealth surveyor, who has the whole Commonwealth territory for surveying purposes in hand. In his offices we were shown contour maps of the whole region, the sites for the water supply, railway, &c. He had in process of making some model relief casts made accurately from the contour maps, and these were being coloured before dispatching them to the various world centres for competition. The competition consists of suggestions for the best arrangement for a "model city," and I believe a valuable prize will be awarded to the winner. Mr. Scribner has a nice little meteorological station in good working order near the camp site.

After lunch we drove a distance of about 6½ miles to the foot of a hill called Stromlow. This hill is 600 feet above the plain below, and its summit is 2600 feet above sea-level. It forms a kind of "Hog's Back" in a north and south direction, the land falling rapidly away on both sides. The eastern horizon is well open, so that solar observations can be made just after sunrise. The observatory site reminds one rather of that chosen for the Solar Physics Observatory at Fosterdown, Caterham, but, of course, on a very much larger scale. As the nearest town to the Stromlow hill will be the capital site, 6½ miles away, and as the latter will be on the leeward side of Stromlow in relation to the prevailing winds, the observatory cannot be rendered ineffective at any reasonably near date. Further, a very large reserve of land all round the hill has been set apart for protective purposes. Both on this and on the hill gum trees are in their thousands, but most of these have been ring-barked, and are therefore dead. The planting of other and quicker growing trees is now going to be undertaken, so that radiation from the ground will be reduced to a minimum. The result of my visit was that I was highly pleased with the site, and Mr. Hunt assured me that the weather conditions all the year round were of the best. The following is the brief report I sent to the Minister for Home Affairs with respect to the Stromlow site:—

AUSTRALIA HOTEL,
SYDNEY,
March 23, 1911.

SIR,

Accompanied by Mr. H. A. Hunt, escorted over the site by Mr. C. R. Scribner, I have now had the opportunity of inspecting the proposed location of the future Solar Physics Observatory. I carefully surveyed the situation with respect to those main requirements which could be judged on inspection, and I feel sure that Stromlow will admirably serve the purpose for the site of a National Observatory such as is proposed.

In selecting a site for a National Observatory for the study of Solar Physics, it is most important that one should look a long time ahead, and that any site selected now should be as good a site in, say, 100 years' time. The Stromlow site seems to be admirably suited in this particular. Again, it is fundamental that the observatory should be situated at a high elevation, because definition for solar observations is best in the very early morning just after sunrise, and an unobstructed eastern horizon is imperative. In fact, solar physics observatories are now situated or are now being removed to high localities to secure these observing conditions, and this result is the outcome of considerable experience.

In the present instance Stromlow is well adapted in this particular, for it is 2600 feet above sea-level and 600 feet above the neighbouring plain, and has an open eastern horizon. The highest points of this site should be utilised for the solar instruments.

Further, the site is good with respect to the western and northern horizons, rendering the location as an observing station one of the highest order.

Another important desideration in the choice of a good site is that the northern, eastern, and western slopes are such that there need be little fear from defects arising from the presence of future buildings on them. On the southern side of the site the plateau is very well adapted for the erection of the main business buildings of the observatory, apart from the observing instruments.

The observatory should be a sufficient distance away from any large town in order to render the sky as little illuminated as possible in the neighbourhood of the observatory from artificial town lights; in addition, it should be situated on that side of the nearest town from which the prevailing winds blow in order to free the

[1] Continued from p. 429.

observatory site from the presence of driving town smoke. These two conditions are, I find, allowed for in the site in question, the Capital site being at a sufficient distance of 6½ miles from the locality and on the eastern side, the prevailing wind being from the north-west.

Another important favourable point in the position of the site is that the area is of sufficient dimensions for the accommodation of the necessary buildings for the observation and study of other allied branches of work, such as meteorology, astronomy, seismology, &c. In the case of magnetism, I would suggest that the *observations* should be made at another site very far removed, while their work of *reduction* should be accomplished in special quarters at Stromlow.

It is very important, further, in the light of modern research, that there should be a rapid means of communication between the head workers in all the above subjects, since the latter are so intimately associated with one another. The bringing together of the various departments into one locality is therefore of considerable value, for instant intercourse and collaboration of the work between the heads of departments can be most efficiently accomplished in this way. For such a large country as Australia this centralisation of work is, I think, the most economical and effective course to take.

Trust that this brief summary of the results of the inspection of the site may serve a useful end,

I have the honour to be, Sir,
Your obedient servant,
WILLIAM J. S. LOCKYER.

The Hon. King O'Malley,
Minister for Home Affairs.

On the evening of March 22 Mr. Hunt and I left by train for Sydney, arriving there at 5 a.m. the next morning. After a short rest I went down to the wharf to see about the ten gallons of spirit which had arrived in the P. and O. steamship *Mongolia*, and had been forwarded by the British Museum authorities for use at Vavau for the preservation of the natural history specimens I proposed to have collected for them. A few days previously I had met Mr. A. W. MacIlwaine, of H.M.S. *Pegasus*, and he told me of the valuable fish collection he had made for the Sydney Museum on a previous cruise. He put me up to all the wrinkles of catching, and escorted me to the museum to introduce me to Mr. Maccullock, who looks after this branch there. Mr. Maccullock kindly supplied me with all the necessary materials for collecting and preserving, and promised to pack our catch properly for dispatch to London as soon as it arrived at Sydney after the eclipse.

Friday, March 24, was spent in packing and saying adieu to many kind friends preparatory to going on board H.M.S. *Encounter* in the evening after seeing Mr. Hunt off by train to Sydney, and I should like to take this opportunity of thanking him for his extreme kindness to me and all of us during the whole time we were in Australia. In Mr. Hunt the meteorology of Australia is in good hands; he and his staff are working at problems of extreme interest, which will be to the benefit of Australia in particular and the world in general.

H.M.S. "Encounter," April 2.

Saturday, March 25, saw us steaming majestically out of the beautiful harbour of Sydney away to far-off Vavau, the scene of our future labours. The ship, with her two tall masts carrying the network of Marconi wires between their tops, and the three funnels sending out the tailings of Newcastle coal, must have looked a pretty sight with the background of abnormal green grass and trees which studded the shores. On board were the two eclipse parties safe and sound, namely, Fathers Cortie and Pigot and Brother McKeon, and my party of Mr. McClean and Mr. Anderson, while safely stowed away below were the eclipse instruments and huts. On board also were some livestock, sheep, cocks and hens, and last, but not least, the ship's goat.

FIG. 1.—Evening Cloudscape in the Doldrums.

The first day out I erected the screen for the three self-recording instruments, which ought to have been used all the way out from Tilbury. Then I adjusted and started the instruments themselves, the screen being placed on the starboard side of the ship well forward of the funnels and against the conning tower. That evening I gave a lecture, having now lantern and slides, the object of which was to explain to the whole ship's company the kind of assistance they could render us both in the preparations and during the eclipse. The lecture seemed to have attained its end, for the captain asked all those who were willing to assist to give their names in by six o'clock on Sunday, *i.e.* the next day. Not only did all the officers come forward, but 168 men handed in their names.

Sunday was occupied in preparing lists of the requirements of assistance at each instrument and for several parties, such as corona drawing, star observations, &c. When this was completed the captain handed it to the commander to portion off the officers and men for the several lines of work. In addition to the eclipse work, there were numerous volunteers for the "'ologies," as the natural history branches were termed. Thus the captain, assisted by Staff-Surgeon Milln, volunteered to do the catching of the butterflies, moths, beetles, spiders, &c., and he stated that Mrs. Colomb (who is on her way to Vavau with other ladies, wives of the officers) was bringing him the killing bottle. Mr. Anderson has occupied himself with geological study preparatory to rock-specimen collecting. The collection of flowers, seeds, and especially fern seeds, will be undertaken by Lieut. Hunt Gruhl, while Mr. Lane, the purser's clerk, was posted by Mr. MacIlwaine, of the *Pegasus*, in the art of catching fish. Lieut. Clover will look after the birds and bats, &c., and will be assisted by Staff-Surgeon Milln in their prepara-

tion. The Rev. Peshall has also volunteered to make a collection of shells, sponges, &c. Thus even if we are clouded out and do not get our astronomical observations, we hope at least to bring back some new material which may advance science in other directions.

On Tuesday, March 28, Father Cortie delivered a lecture on "Eclipses in General," while the following evening Mr. McClean was persuaded to describe and give his experiences on aëroplanes. In fact, we have all been most busy, and the ship has been rolling and pitching nearly all the time, and a stiff head wind N.E. has been blowing.

On March 31 we were invited to a concert given by the ship's company, which proved very successful.

Early this morning (April 2) we passed on our starboard side the islands of Tofua and Kao; both are volcanoes, the former active, but there were no signs of activity. Tofua lies in the centre of the eclipse track, but has not been looked upon as a suitable place for an eclipse station. On our port side we are now nearly abeam of Late Island, a lonely peak in this landless ocean. In fact, except for a very few birds and a few flying-fish, the ocean and air have been lifeless. The barograph is daily marking out the diurnal double oscillation superimposed on long waves of rise and fall. The temperature has been steadily rising, and has now reached the eighties. The hydrograph persistently records more than 80 per cent. of saturation, but on the moving ship this humidity is not very much felt except when violent exercise is indulged in. We are now in very quiet trade winds, and the good ship *Encounter* is becoming more steady. To-night, or rather this afternoon, we expect to arrive at our destination, and then we shall feel the effects of the temperature and humidity.

At the present moment no decision has been arrived at as to whether we shall live on board or ashore. Most probably it will be the latter. Our present intention is to occupy the spot indicated on the large-scale map of Vavau portioned off as a naval coaling station, for the harbour is sufficiently deep for the ship to lie just off. This harbour has only a very narrow entrance, so that the ship will be well protected from strong winds and landing will be easy.

To-morrow morning (April 3) will be spent in looking for a suitable site, and then on the following day the Union Steamship Company's mail boat arrives from Auckland, bringing the Australian astronomers and the other members of my party, namely, Messrs. Brooks, Raymond, and Winkelmann.

I have arranged with Captain Colomb that, should we be successful on the day of the eclipse, the ship will not leave Vavau until about May 5. The object of this is to give us plenty of time quietly to develop and copy all negatives; as the climate is so hot and humid, particular care must be taken to produce the best results, and it is quite possible that development may only be successfully accomplished during the cool (!) of the night. In the case of our being clouded out, Vavau will be left on May 2. On her return journey to Sydney, H.M.S. *Encounter* will make for Suva, Fiji, to coal, and to land Mr. McClean and myself there.

It is now 11.30 a.m., and two small patches of land ahead give us the first imprint of Vavau, our future home for some time to come. At last we are there after this long journey.

W. J. S. LOCKYER.

THE PRIVATE SESSIONS OF THE IMPERIAL EDUCATION CONFERENCE.

IN our review of the public sessions of the conference (see NATURE, May 4), we hoped that the report of the private sessions would reveal a useful interchange of ideas between the delegates from various parts of the Empire, and that organised concerted action would result. The report (Cd. 5666, price 1*s*.) issued by the Board of Education is now before us, and we may state at once that it disposes of the fear—to which the character of the public meetings naturally gave rise—that the Colonial Governments had not been duly consulted with reference to the agenda of conference. Furthermore, we believe that the debates have been of a useful character, and that an important step has been taken to fulfil our aspirations by the organisation of an Imperial Education Bureau. The agenda of the meetings may be summarised as follows:—(1) action arising from the previous conference in 1907; (2) memoranda prepared by the Office of Special Inquiries and Reports on schools in the self-governing dominions; (3) training and qualifications of teachers; (4) cost of instruction and cost of living in connection with advanced technical colleges and universities; (5) the Board's examinations in the overseas dominions; (6) the formation of an Imperial Education Bureau.

Two mornings were devoted to problems of an educational, rather than administrative, character. English spelling and spelling reform formed the subject of papers by Dr. E. H. Edwards (H.M.I., England) and Dr. A. H. Mackay (Nova Scotia); also Dr. W. J. Viljoen (Union of South Africa) contributed interesting information with reference to the simplification of Dutch orthography and grammar. H.E. the Governor of Sierra Leone submitted a paper, written by R. F. Honter, on the psychology of the negro child and on the adaptation of primitive customs, manners, laws, and traditions in a system of education. Sir F. D. Lugard, Governor of Hong Kong, presented a memorandum on the best methods of training character and inculcating a high moral standard in universities founded primarily for non-Christian races, without the compulsory teaching of the Christian religion, and this subject is to be considered further at the next conference. Among the appendices is a report of the Conference on Bilingualism, convened by the President of the Board of Education. The discussion of this question by representatives of South Africa, Canada, the India Office, Scotland, Wales, and Malta, brought clearly into view the desirability of bringing into the common stock the varied knowledge and experience of administrators under diverse conditions.

But the success of the conference rests upon its treatment of the urgent administrative problems indicated in our six items of summarised agenda, especially in regard to the last. Much credit is due to Dr. Frank Heath, as director, and his staff at the Special Inquiries Office. Their activity has been even more productive than appeared from Mr. Runciman's address (*vide* NATURE, *loc. cit.*), as the interchange of officials, as well as of official memoranda, has been facilitated, and the difficulties of mutual recognition of teachers' certificates are approaching solution. The main outcome of the conference is the extension of the work of Dr. Heath's department. If the unanimous and weighty recommendations of the conference are carried into effect, the Office of Special Inquiries and Reports will perform the functions of an Imperial Education Bureau. The machinery by which these functions are to be performed, the provision for the continuity of the conference, modes of cooperation of the several education departments of the Empire, have all been made the subject of definite proposals of a practical character. From these, which will be found on pp. 12 to 18 of the report, we quote the penultimate recommendation:—

"That the several Education Departments of the Empire should publish, each for their own part of the Empire, the following monographs in the order named:—(*a*) the curricula of schools for general education; (*b*) the training of teachers for schools giving general education; (*c*) the laws of compulsory attendance and their working; (*d*) the general education of children in sparsely populated areas; and (*e*) the medical inspection of schools for general education."

G. F. DANIELL.

THE ENDOWMENT OF HOME SCIENCE.

IT was announced on Friday last (the Queen's birthday) that a sum of 50,000*l*. had been subscribed for the endowment of "home science" in connection with the Women's Department of King's College, and that her Majesty had graciously allowed her name to be associated with a new hostel to be erected at a cost of 20,000*l*. Another 20,000*l*. is to be used for building and equipping laboratories, and it is hoped to supplement the remaining 10,000*l*. so that the endowment for salaries and current expenses may be 60,000*l*.

A trust fund committee has been formed to receive moneys given for the foregoing purpose, composed of the following:—the Marquis of Anglesey (chairman), Sir William Anson, M.P., Mrs. Asquith, Mr. Balfour, Lord Justice Buckley (hon. treasurer), Viscountess Esher, Lady Meyer, Sir Arthur Rücker, F.R.S., Lady Rücker, and Dr. John Atkins (hon. secretary).

The funds will be administered in accordance with the terms of the trust deed by an executive committee composed of representatives of the donors and of King's College for Women, including the Rev. Dr. Headlam, Prof. Jackson, Dr. Miers (the principal of the University of London), Miss Oakeley, Lady Rücker, and Prof. Smithells.

Among those who have generously contributed to the fund raised for the purposes of the endowment of King's College for Women are:—the Marquis of Anglesey, Mrs. Asquith, the Duke of Devonshire, Sir Richard Garton, Sir Carl Meyer, Lady Mond, Mr. Almeric Paget, M.P., Mrs. Almeric Paget, the Earl of Plymouth, Messrs. Rothschild and Sons, the Marquis of Salisbury, the Earl of Scarbrough, Lady Wantage, and the Duke of Westminster.

The Times in a leading article on Saturday, May 27, warmly eulogises the new departure, which, it says, "will be received throughout the country with universal satisfaction and sympathy."

This sudden and remarkable development will be hailed with satisfaction by those who during the last two years have been engaged in carrying out in connection with King's College, under great difficulties, the first attempt made in a university institution in this country to establish a course of higher education for women, centring round home and institutional life. In spite of the unsuitable accommodation and lack of funds, a beginning has been made, and those who are in charge of the scheme are confident of its value and permanent success. Now that funds and influential support are forthcoming, the chief obstacle to progress will probably consist in the difficulty of winning the goodwill of the educational world.

It is a little unfortunate that there is no good term available for indicating the range of studies that are comprised in the King's College course. The expression "home science" is not very felicitous, and it is to be regretted that its classical equivalent, economy (Οἰκονομία) or economic science, has lost its original significance. The pleonasm, domestic economy, has, not without good reason, fallen into disrepute. But whatever be the term used, it can hardly be doubted that, as in agriculture and other crafts, long left in the empiric state, it should be possible to delimit and develop a tract of higher intellectual studies which will rationalise and inform the vastly important work of household administration.

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA.

AT the International Congress of Applied Chemistry held in London in 1909, an International Commission was appointed for the purpose of compiling and publishing annual tables of constants and numerical data, and this commission was subsequently accorded the patronage of the International Association of Academies at the meeting of that body held in Rome in 1910 (NATURE, May 26, 1910, p. 371).

According to the programme drawn up by the commission, the tables published in any one year are intended to contain all the numerical data likely to be of interest in connection with chemistry, physics, and allied sciences, pure and applied, to be found in the literature published during the previous year. The data are to be accompanied by full bibliographic references. This programme has now (May) so far matured that portions of the volume for 1910 are already in the press, while the manuscript of the remaining portions is approaching completion.

Owing to the immense volume of scientific and technical literature which is continually being produced, the difficulties in the way of finding out whether any given measurement has been made or not are increasing year by year. Existing systems of indexing and abstracting offer only limited help, since a large number of measurements are made in the course of researches to which they are purely subsidiary, so that their existence cannot be inferred from the titles and subtitles of the papers in which they are recorded. Also tables which appear only at long intervals, such as those of Landolt and Börnstein, can of necessity cover only a small part of the ground, and, moreover, in most cases they are hampered by the limitations of private enterprise. The annual tables should therefore fill a serious gap which has hitherto existed in the systematic indexing of scientific and technical results.

It is hoped that ultimately the enterprise may become self-supporting; but obviously this cannot be the case for some time to come The commission has been greatly assisted by grants from various societies; for example, in this country, from the British Association, Chemical Society, Faraday Society, Royal Dublin Society, Royal Irish Academy, Royal Society of Edinburgh, and the Society of Chemical Industry. Donations have also been received from a few private persons, notably from the Earl of Berkeley, F.R.S. The financial position is, however, still far from satisfactory, and further help from societies and private donors is urgently needed. In this connection it may be mentioned that neither the general secretary nor the members of the commission receive payment for their services, except in so far as they may perform actual compiling or abstracting.

The organisation of the commission is sufficiently complete to deal effectively with the periodical literature, but it happens occasionally that data are published only in non-periodical publications, such as books or monographs, and such data may easily be overlooked. Accordingly, in order that the annual tables may be as complete as possible, the authors of such books, monographs, &c., are requested to communicate with one or other of the members of the commission. In cases where the data are numerous, specimen copies or corrected proofs of the tables containing the data would be very acceptable.

The members of the International Commission for the United Kingdom are:—Dr. Alex. Findlay, The University, Edgbaston, Birmingham; Dr. R. T. Glazebrook, C.B., F.R.S., The National Physical Laboratory, Teddington, Middlesex; and Dr. N. T. M. Wilsmore, University College, Gower Street, London, W.C. The general secretary is Dr. Charles Marie, 98 Rue du Cherches-Midi, Paris VI.

STANDARD TIME-KEEPING.

APPARENTLY the efforts of the British Science Guild to show the commercial need that exists for a more widespread observance of standard time than exists at present (see NATURE of February 16) have already attracted some attention, for last week we had an opportunity for inspecting a demonstration of yet another clock synchronisation system, to be made available by the Greenwich Time Co., which, we believe, is either a branch or offspring of the Normalzeitgesellschaft of Berlin, where there are about 30,000 clocks under the control of the company.

The company has offices in Albany Street, N.W., where a Time Bureau is to be established, and by means of the usual arrangements with the Post Office authorities, the Greenwich time signal is transmitted to the bureau over wires provided for the purpose. This signal controls a regulator clock, the function of which is to control electrically, half a dozen times during the day, other clocks in subscribers' premises. These clocks are arranged so as to report back their behaviour at certain times. If the synchronisation is reasonably efficient, the latter appears to us to be a rather unnecessary procedure. We gather that the company is prepared to let out, on hire, clocks suitable for this purpose for an annual rental of something under 2*l.* per clock. This seems rather expensive for subscribers who require a number of clocks, as must be so in the majority of cases, for the whole of the utility of a synchronisation scheme depends upon *every* clock showing the same time.

We observe that some of the reports in the daily Press hailed the inauguration of this company as something entirely novel, but, as readers of NATURE will remember, the scheme is not at all a new one; in fact, the Post Office authorities have for a long time been synchronising their old clocks, and it seems desirable to place on record

again that the Standard Time Co. has offered the public time service in London for many years. Then many of the electric clock firms, notably the Silent Clock Co., the Synchronome Co., and the Aron Time Distribution Co., have for a considerable time offered trustworthy synchronised Greenwich clocks to the public at rates which are, we believe, lower than those quoted by the new company. We wish every success, however, to a laudable endeavour to ensure accuracy in time-keeping.

ARCTIC TIDES.[1]

THE Coast and Geodetic Survey of the United States has just published the summarised account of the tides of the Arctic Ocean, based on the observations made by Peary's expedition and on those by Messrs. Mikkelsen and Leffingwell at Flaxman Island, to the north of Alaska. The recent Russian observations at Taimur Bay and on one of the New Siberian Islands are not yet available for inclusion. Peary's observations were made at Cape Sheridan, Port Aldrich (near Cape Columbia), Cape Bryant, Cape Morris Jesup, and Fort Conger for periods ranging from seven and a half months, November 12, 1908, to June 30, 1909, at Cape Sheridan, to fourteen days at Fort Conger; and hourly heights of the tide are given, as well as for Flaxman Island in 1906. These are followed by a table giving the principal harmonic constants for all stations north of the sixtieth parallel where such constants are at present available, and fifty-four of these have been collected. Besides this, however, the same region furnishes a long range of data from many points which have been obtained by successive explorers, and these have been brought together to show the intervals, ranges, tidal hours, &c., from all published sources, and to deduce from them the mean ranges of the semi-daily tide and the mean tidal hours.

A co-tidal chart from the Pole to latitude 65° shows the results arrived at by means of lines giving the Greenwich lunar time of mean high water, and on this chart a large area of about half a million square miles between Alaska and the Pole is represented as being land but slightly submerged. The following facts are quoted as showing the necessity for such land or shoals: at Point Barrow the flood stream comes from the west; the range of the semi-daily tide at Bennett Island is 2·5 feet, whereas it is but 0·4 foot at Point Barrow and 0·5 foot at Flaxman Island; the observed tidal hours and ranges of tide show that the semi-daily tide is not propagated to the Alaskan coast directly across a deep and uninterrupted polar basin. Not only the position of such a land area is indicated, but its approximate shape is given as roughly trapezoidal, for certain points are suggested by velocity and direction of currents, by Peary's Crocker's Land, and by some of his soundings.

This paper provides a useful and instructive summary of the tidal movements of the Arctic Ocean so far as they are known, and makes a very suggestive addition to our knowledge of the distribution of north polar lands.

[1] "Arctic Tides." By Rollin A. Harris. (Washington: Coast and Geodetic Survey, 1911.)

AVIATION NOTES.

MR. WINSTON CHURCHILL has wisely amended his "Aërial Navigation Bill," and transformed a measure which, in its original form, promised to kill aërial navigation into one of comparatively small importance. The Bill as it now stands provides that if any person navigates any kind of air vessel over any area prescribed by order of the Home Secretary, unless he can prove that he was compelled to do so by stress of weather or other uncontrollable circumstances, he shall be guilty of an offence, and be liable to six months' imprisonment or a fine of 200*l.*, or both.

The prime object of the Bill is to prevent any daring or reckless aviator from flying over the Coronation processions. It is, however, an open question whether it would succeed in its aim were it not that the Royal Aero Club has requested aviators not to do so, and has provided a penalty for disobedience—the suspension of the certificate of proficiency. It will be perfectly obvious that an aviator could pass high over the processions without incurring any penalty whatsoever. At a height of 1500 feet and upwards the identity of the pilot would be unrecognisable.

M. Jules Védrines has performed an extraordinarily fine feat in flying from Paris to Madrid, a distance of 660 miles, in 12h. 15m., thus winning the prize offered by the *Petit Parisien*. The flight was accomplished on a Morane monoplane fitted with a 50 horse-power Gnome motor and an "Integrale" propeller. M. Védrines started from Issy-les-Moulineaux on May 22, reaching Angoulême, 250 miles away, in 3h. 42m. 18s. The second stage, to San Sebastian (193 miles), took 3h. 43m. 19s., and the final stage, on May 26, to Madrid (220 miles), took 4h. 48m. 42s. The times given are those of actual flight; but it is satisfactory to note that the first two stages were flown without a stop, and only one halt made in the last stage, owing to the breaking of a valve spring in the motor.

The most notable advance recently made in the improvement of aëroplanes has just been successfully tested near Versailles. M. Henry Farman has fitted a silencer to the motor of his military-type biplane, which was already furnished with a wireless telegraphy transmitter. The motor—a Renault—worked without a hitch.

A meeting of the Aërial League of the British Empire was held at the Mansion House on Wednesday of last week to promote a special Coronation appeal for 250,000*l.* for the establishment of a National Institute and School of Aëronautics. The following motion (moved by Sir E. Shackleton) was put to the meeting and carried unanimously:—"That this meeting of the citizens of London and the Empire supports the principles laid down in the circular issued by the Aërial League of the British Empire, and pledges itself to do all in its power to assist the League in its efforts on behalf of the advancement of aëronautics," as was also the following (proposed by Mr. Joynson-Hicks, M.P.):—"That a Coronation fund be raised for the purpose of inaugurating a National Institute and School of Aëronautics."

NEW ORGANIC COMPOUNDS OF NITROGEN.[1]

IN the diversity of behaviour exhibited by its derivatives, nitrogen is unrivalled by any other element. This is illustrated not only by the contrasting properties of ammonia, hydrazine, and azoimide, substances composed solely of nitrogen and hydrogen in different proportions, but also by the chemical, physiological, and æsthetic variations displayed by organic compounds of nitrogen, such as nitrocellulose, indigo, azo-dyes, alkaloids, enzymes, and proteins.

Azoimide or hydrazoic acid, HN_3, discovered by Curtius in 1890, is the parent of a series comprising numerous highly reactive organic compounds, the first of which—phenylazoimide—was brought to light by Peter Griess in 1866, after which date the subject lay dormant for more than twenty years. Two methods are applied commercially to the production of sodium azide; the first, described by W. Wislicenus (1892), consisting in passing nitrous oxide over heated sodamide; the second, due to Stollé and Thiele working independently (1908), depending on the interaction of hydrazine, sodium ethoxide, and an ethereal nitrite. In consequence of these, the salt, originally a chemical curiosity, may now be purchased at 40*s.* per pound, largely owing to the simple and inexpensive preparation of hydrazine devised by Raschig (1908). The principal methods by which organic derivatives of azoimide may be obtained are:—

(1) Action of nitrous acid on a substituted hydrazine, applied by Curtius to the production of numerous acyl azoimides.

(2) Addition of hydrazoic acid to a diazonium sulphate, found by Noelting to yield aromatic azoimides quantitatively.

(3) Interaction of organic halides and sodium azide, as practised at the Royal College of Science in preparing aliphatic azoimides.

[1] Abstract of a discourse delivered at the Royal Institution on Friday May 5, by Prof. Martin O. Forster, F.R.S.

It commonly happens that the materials thus obtained are, like the parent compound, explosive, and they are, moreover, very sensitive to light. From a study of their refractive power, it appears that in the aliphatic series the increment of refraction for the triazo-group is 8·91 as compared with 8·93 for bromine; and whilst the atomic dispersion of this halogen is 0·35, that attributable to the triazo-group is 0·36. Moreover, the elevation of boiling point produced by this complex lies between those due to bromine and iodine, whilst the effect on the dissociation constant of an aliphatic acid exceeds that of iodine, but is less than that of bromine. Thus the physical evidence supports those chemical characteristics which classify the triazo-group as a complex radicle having a strong family resemblance to the halogens.

The changes undergone by triazo-compounds may be referred to one of three main types:—

(1) Liberation of two nitrogen atoms in elemental form, leaving the third attached to the carbon which originally carried all three. This is exemplified by triazoantipyrine, which passes spontaneously into a red azo-compound, whilst in triazoacetone, triazocamphor, and triazoacetic acid the change is accelerated by alkali. Sometimes this type of alteration is violently explosive, as in the case of triazoacetic azide.

(2) Unfolding of the three-atom nitrogen ring into a straight chain such as occurs in diazoaminobenzene or in the cycloid tetrazole. Allylazoimide, for instance, a colourless liquid, changes spontaneously into an isomeric solid which no longer contains the triazo-group, whilst hydrazoic acid converts prussic and fulminic acids into tetrazole and hydroxytetrazole respectively.

(3) Complete removal of the triazo-group in the form of hydrazoic acid. The simplest example of this change is found in the behaviour of triazomethylamine derivatives, which liberate hydrozoic acid when treated with cold water; this happens also when triazotised carbon is associated with a halogen, as in the case of triazoethylene dibromide, but more generally this type of decomposition requires the action of alkali.

Although the preparation of chloroazoimide by Raschig (1908) indicates the possibility of producing hexatomic nitrogen by the union of two triazo-groups, this new form of the element has not yet been realised.

A NEW METHOD OF CHEMICAL ANALYSIS.[1]

I HAVE had on several occasions the privilege of bringing before the members of the Royal Institution some of the results of the experiments on the positive rays on which I have been engaged for the last few years. I wish this evening to direct your attention to some applications of these to various chemical problems.

The first application I shall consider is the use of these rays to determine the nature of the gases present in a vacuum tube, to show how they can be used to make a chemical analysis of these gases—an analysis which, as we shall see, will enable us to determine, not merely whether an element, say, for example, oxygen, is present in the tube, but will tell us in what form it occurs, whether, for example, it is present in the atomic as well as the molecular condition, and whether there are allotropic modifications present, such as ozone, O_3, and other still more complex aggregations.

The method is as follows: the positive rays, after passing through a fine tube in the kathode, are exposed simultaneously to magnetic and electric forces, the magnetic field being arranged so as to produce a vertical deflection of the rays, while the electric field produces a horizontal deflection. Thus, if when neither electric nor magnetic fields are present, the rays strike a screen placed at right angles to their direction at a point O, they will, when both electric and magnetic forces are at work, strike it at a point P, where the length of the vertical line PN is equal to the deflection produced by the magnetic field, and the horizontal line ON to that produced by the electric field.

We know from the theory of the action of electric and magnetic fields on moving electrified particles that

$$PN = A\frac{e}{v} \qquad ON = B\frac{e}{mv^2}$$

where A and B are constants depending on the strength of the magnetic and electric fields and the geometrical data of the tube, e is the charge on the particle, m its mass, and v its velocity.

From these relations we see that

$$\frac{m}{e} = \frac{A^2}{B}\frac{ON}{PN^2}.$$

When these rays strike against a photographic plate, they affect the plate at the point against which they strike, and thus when the plate is developed we have a permanent record of the deflections of the rays. The methods of taking these photographs and the details of the experiment are described in my paper in *The Philosophical Magazine*, February. The values of A and B can be determined accurately by the methods I have given in previous papers, and hence if we measure on the photographs the values of ON and PN, we can determine the value of m/e. If we wish to compare the values of m/e for two different rays, it is not necessary to determine A and B; all we have to do is to measure the values of ON and PN, and thus the photograph alone gives us the means of comparing the value of m/e.

Since for the same type of carrier m/e is constant, so that whatever may be the velocity $\frac{PN^2}{NO}$ is constant, and therefore the locus of P, *i.e.* the curve traced on the photographic plate by this carrier, is a parabola. The reason we get a curve instead of a point is that the rays are not all moving with the same velocity, and the slower ones suffer greater deflection than the quicker ones. Each type of carrier produces its own line on the plate, and there are as many curves on the plates as there are kinds of carriers; from an inspection of the plates we can find, not merely the number of kinds of carriers, but from the dimensions of the curves we can at once determine the atomic weight of the carrier, and thus determine its nature. This is one of the great advantages of this method. To illustrate this advantage, let us compare the method with that of spectrum analysis. If the spectroscopist observes a line unknown to him in the spectrum of a discharge tube, the most he can deduce without further investigation is that there is some unknown substance present in the tube; and even this would be doubtful, as the new line might be due to some alteration in the conditions of the discharge. But if we observe a new curve in the positive-ray spectrum, all we have to do is to measure the curve, and then we know the atomic weight of the substance which produced it. To take an example, I have photographed the positive-ray spectrum for nitrogen prepared from the atmosphere and that for nitrogen prepared from some nitrogenous compounds, and have found that the former contains a line[1] which is not in the latter, and that the value of m/e for this line is 40 times that for the atom of hydrogen. We thus know that atmospheric nitrogen contains an element of atomic weight 40, which is not present in chemical nitrogen—this element is, of course, argon. We might by ordinary spectrum analysis have found lines in the spectrum of atmospheric nitrogen which are not in the spectrum of chemical nitrogen, and might thus have suspected the presence of another element; but spectrum analysis could not tell us anything about the nature of this element, whereas the positive-ray spectrum at once gives us its atomic weight.

The positive-ray method is even more delicate than that of spectrum analysis, for by it we can detect the presence of quantities of a foreign gas too minute to produce any indication in the spectroscope. I have, for example, often been able to detect the presence of helium by this method when no indication of its presence could be detected by a spectroscope.

Again, when a line in the positive-ray spectrum can be seen, the atomic weight of the carrier which produces it can be determined with great accuracy. Though the method is only a few months old, it is even now sufficiently developed to determine with an accuracy of 1 per

[1] Discourse delivered at the Royal Institution on Friday, April 7, by Sir J. J. Thomson, F.R.S.

[1] As a matter of fact, there is a second, very faint line for which m/e is about twenty times that for the atom of hydrogen. This is probably due to an atom of argon with two electric charges.

cent. the atomic weight of a gaseous substance, without requiring more than 1/100 milligram of the substance. Another very important advantage of this method is that it is not dependent upon the purity of the material; if the material is impure, the impurities merely appear as additional lines in the spectrum, and do not affect the parabola due to the substance under examination, and therefore produce no error in the determination of the atomic weight. The method would seem to be peculiarly suitable for the determination of the atomic weights, not

FIG. 1.

merely of the emanation from radio-active substances, but also those of the products into which they disintegrate.

The rays, too, are registered within less than a millionth of a second after their formation, so that when chemical combination or decomposition is occurring in the tube, the method may disclose the existence of intermediate forms which have only a transient existence, as well as of the final product, and may thus enable us to gain a clearer insight into the process of chemical combination.

I will now show a few slides prepared from the photographs we have taken of the positive-ray spectra. The first (Fig. 1) is that of nitrogen prepared from air; the measurements of the photograph showed that the atomic weights of the carrier producing these curves were as follows:—

Positive	Negative
1 H_+	1 H_-
1·99 H_{2+}	11·20 C_-
6·80 N_{++}	15·2 O_-
11·40 C_+	...
13·95 N_+	...
28·1 N_{2+}	...
39 A_+	...
100 Hg_{++}	...
198 Hg_+	...

The symbol H_+ denotes that the carrier is an atom of hydrogen with one charge; H_{2+} that it is a molecule of hydrogen with one charge; N_{++} that it is an atom of nitrogen with two charges; and so on.

FIG. 2.

With nitrogen from NH_4NO_2 the lines were as follows (the magnetic force was so large that some of the lines corresponding to the lighter particles were thrown off the plate):—

6·1 C_{++}	44·2 CO_{2+}
7·02 N_{++}	65·5 Hg_{+++}?
12·08 C_+	100 Hg_{++}
14·01 N_+	204 Hg_+
27·9 N_{2+}	

The next slide (Fig. 2) is the positive-ray spectrum for CO, and again the magnetic field is so great that the lighter carriers do not appear.

From the measurement of the lines we find that the atomic weight of the carrier is

Positive	Negative
6·00 C_{++}	12 C_-
6·95 N_{++}	16 O_+
7·95 O_{++}	...
12·02 C_+	...
13·9 N_+	...
15·95 O_+	...
28·05 CO_+	...
43 CO_{2+}	...
69·5 Hg_{+++}(?) very faint	...
100 Hg_{++}	...
202 Hg_+	...

The spectrum for CO_2 is represented in Fig. 3; the atomic weights are:—

5·98 C_{++}	43·9 CO_{2+}
8·00 O_{++}	62·5 Hg_{+++}(?) very faint
12·00 C_+	99·6 Hg_{++}
16·00 O_+	200·0 Hg_+
28·02 CO_+	

The spectrum of CH_4, of which a small region with five lines close together is shown in Fig. 4. This is interesting, because the measurement of these lines shows that their atomic weights are 12, 13, 14, and 15, 16, and thus that we have here C, CH, CH_2, CH_3, CH_4. If I am not mistaken, this is the first occasion when the atoms CH, CH_2, CH_3 have been observed in a free state.

FIG. 3.

The spectrum of the analogous compound chloroform, $CHCl_3$, is represented in Fig. 5. The atomic weights represented in this are:—

1 H_+	18·5 Cl_{++}
1·5 (?)	27·7 CO_+
2 H_{2+}	36 Cl_+
3 (?)	46·5 CCl_+
6 C_{++}	63 (?) faint
8 O_{++}	81 CCl_2
11·9 C_+	102 Hg_{++}
13·7 N_+	201 Hg_+
16 O_+	

The carriers with atomic weights 1·5 and 3 have not been identified. They are of frequent occurrence. I have here two slides, one of SiH_4 (Fig. 6) and the other of the residual gas in the tube, in which they are well marked, though at their best they are only faint lines. In Fig. 7 we have the positive ray spectrum of air, taken under conditions which produce very narrow lines, which can be accurately measured.

Let us now consider some of the results brought to light by these photographs. In the first place, they show that a gas through which an electric discharge is passing is a much more complex thing than a collection of molecules all equal to each other. Even an elementary gas becomes in these circumstances a mixture of a great many different substances. Thus, to take oxygen as an example, the photographs show that when a current of electricity passes through it, we may have present simultaneously oxygen in the following states:—

(1) Ordinary molecular oxygen, O_2.
(2) Neutral atoms of oxygen, O.
(3) Atoms of oxygen with 1 positive charge, O_+.
(4) Atoms of oxygen with 2 positive charges, O_{++}.
(5) Atoms of oxygen with 1 negative charge, O_-.
(6) Molecules of oxygen with 1 positive charge, O_{2+}.
(7) Ozone with a positive charge, O_{3+}.
(8) O_6 with a positive charge, O_6.

And, in addition, there are free negative corpuscles. Thus in the elementary gas there are at least nine (the list has no claim to be exhaustive) separate substances present when the discharge passes through it. Each of these substances has almost certainly different properties, possibly a characteristic spectrum. If we took any other gas we should find that the same thing would be true: thus in hydrogen we have H, H_2, H_+, H_-, H_{2+}, even if we do not ascribe to hydrogen the lines giving $m/e=1\cdot5$ or 3. In nitrogen we have N, N_2, N_+, N_{++}, N_{2+}, carbon occurs as C_+. C_{++}. C_-, chlorine as Cl, Cl_2 Cl_+, Cl_{++}, and Cl_-, mercury as Hg, Hg_+, Hg_{++}, and probably as Hg_{+++}, as there is a very persistent line for which m/e is about 66.

Thus, whenever the electric current passes through a gas, and probably whenever a gas is ionised, the gas becomes a mixture of many different substances. We can thus readily understand why in the spectra of many elements many of the lines may be grouped together so as to form different series—the principal series, the first coordinate series, and so on—and the spectrum of the discharge tube regarded as the superposition of a number of different spectra the relative intensities of which may be subject to very great variations. This, indeed, is just what would happen if some or all of the substances which are present when the gas is in the ionised state gave rise to different spectra.

FIG. 4.

Another feature which I think is of great interest from the point of view of the theory of chemical combination is the occurrence of particles with negative charges. Let us consider for a moment how these are formed. They are formed after the particles have passed through the kathode; the path between the kathode and the photographic plate contains abundance of corpuscles produced by the ionisation of the gas; a neutral particle, after passing through the kathode, picks up a negative corpuscle, and so becomes negatively charged. For this to occur, the attraction between the corpuscle and the neutral particle must be exceedingly strong, for it is not a question of a particle at rest attracting to itself a negatively electrified corpuscle sauntering about in its neighbourhood. In our case the neutral particle is rushing past the corpuscle with a velocity of the order of 10^8 cm. per sec. In order that the particle may in these circumstances be able to drag the corpuscle along with it, the attraction between the two must be so great that to move a corpuscle against this attraction from the surface of the particle away to an infinite distance must require an amount of work of the same order as that required to communicate to the corpuscle a velocity of 10^8 cm. per sec.; this is equal to the work required to move the atomic charge against a potential difference of about 3 volts, and is therefore comparable with the work required to dissociate some of the most stable chemical compounds.

The fact, then, that some particles get negatively charged shows that in the neutral state these particles have an exceedingly strong affinity for a negatively electrified particle, while the absence of a particular particle from the negative side shows that its affinity is much less, but does not imply that it vanishes altogether. From what we have said, it should follow that the more slowly the neutral particles are moving relatively to the corpuscles, the more easily will the negatively electrified systems be formed. This is confirmed in a very striking way by our experiments, for when the discharge is passing very easily through the tube, and the velocity of the neutral particles is relatively small, the number of negatively electrified particles is very much increased; indeed, in some cases the brightness of the part of the photograph corresponding to the negative particles is as great as that corresponding to the positive, whereas when the discharge is passing with great difficulty, and the velocity of the neutral particles is very high, the negative part is very faint compared with the positive.

The particles which have been observed on the negative side are the hydrogen atom, the carbon atom, the oxygen atom, and the chlorine atom. The presence of oxygen and chlorine atoms might, perhaps, have been expected, as these are universally regarded as strong electro-negative elements, *i.e.* as elements which have a strong affinity for negative electricity. The presence of the hydrogen atom is more remarkable, for hydrogen is generally considered to be a strongly electro-positive element, yet on these photographs we find it more persistently on the negative side than any other particle; often when no other line on the negative side is strong enough to be detected, the line corresponding to the hydrogen atom is distinctly visible. This is all the more remarkable, because the hydrogen atom, being the lightest of all the particles, is moving with the greatest velocity relatively to the corpuscles, and therefore would, other circumstances being the same, be the least likely to capture them. The heavier the particle, the slower is its velocity, and the greater chance it has of capturing the corpuscles; the fact that heavy complicated particles are conspicuous by their absence on the negative side shows that the attraction of these for the corpuscles must be exceedingly small compared with that exerted by a neutral atom of hydrogen. It will be seen that the atom of carbon, also regarded as an electro-positive element, is also conspicuous on the negative side.

FIG. 5.

On looking at the list of the particles which occur on the negative side, we are struck by the fact that they are all atoms: there is not a molecule among them. Thus, although the curve corresponding to the negatively electrified hydrogen atom occurs on every plate, there is not a single plate which shows a trace of a curve corresponding to a negatively electrified hydrogen molecule, although that corresponding to the positively electrified molecule is always present, and on some of the plates is stronger than that due to the positive hydrogen atom. Again, on some plates the positive oxygen molecule shows stronger than the oxygen atom, but on the negative side only the atom is visible.

Thus neutral atoms, but not neutral molecules, can exert on the negative corpuscles those enormous attractions which, under the conditions of these experiments, are required to bind the corpuscles to these rapidly moving particles. We may compare this result with the properties ascribed by chemists to bodies when in the nascent condition, *i.e.* when they have only recently been liberated from chemical combination, and when they are likely to be partly in the atomic state, for atoms, as we have seen.

exert forces on electric charges in their neighbourhood vastly greater than those exerted by molecules.

We may compare the forces exerted by a neutral atom on the corpuscles with those exerted by an unelectrified piece of metal on a charged body in its neighbourhood. In consequence of electrostatic induction, the charge and the metal will attract each other. This attraction is dependent on the electricity in the metal being able to move under the electric forces exerted by the charge, and to rearrange itself in such a way that if the charge is positive, the negative electricity in the metal moves to the part of the metal nearest to the charge, while the positive electricity moves to the part remote from the charge. The force between the metal and the charge depends on the freedom of the electricity to move about in the metal under the action of the electric field. If the metal is replaced by a substance of high specific inductive capacity, like sulphur, in which the electricity has an appreciable amount of freedom, though not so great as in a metal, the attraction, though still appreciable, is very much less than it was with the metal. A very simple experiment will illustrate this point. I have on this cardboard disc, which is suspended from a long string, a number of magnets such as are used for compasses; if I mount the magnets on pivots, so that they are free to turn round, the system of magnets is strongly attracted when another magnet is brought near it; if, however, I take the magnets off their pivots, so that they are no longer free to turn, the magnet exerts very little attraction upon them.

FIG. 6.

A view of chemical combination which I gave some time ago in *The Philosophical Magazine*, and also in my "Corpuscular Theory of Matter," suggests that there is a very close analogy between the causes at work in the experiment we have just made and those which produce the difference between the behaviour of atoms and molecules. On that theory the atom was supposed to consist of a large number of corpuscles arranged inside a sphere of positive electricity, the corpuscles arranging themselves so as to be in equilibrium under their mutual repulsion and the attraction of the positive electricity. The configuration depends on the number of corpuscles, and the stiffness and stability of the system also change as the number changes. For some particular numbers of corpuscles the system is very rigid, and any movement of the corpuscles would be strongly resisted; since the movement of electricity inside the atom is brought about by the movement of the corpuscles, the electricity could only move with great difficulty inside these atoms, and they would therefore not be able to exert more than feeble forces on electrical charges outside the atom: they would therefore not enter readily into combination with other atoms. We may ascribe such a constitution as this to the atoms of the inert gases, helium, argon, and neon. A system with one, two, or three more corpuscles than the system we have just described would not be nearly so stable, and there would be a tendency to discard the extra corpuscles from the atom so that it might return to the more stable form. We may roughly picture to ourselves the atom with one extra corpuscle as consisting of a number of fixed corpuscles plus one which is free to move about; the freedom of this corpuscle would enable the electricity in the atom to move about, and would endow the atom with the property of attracting any electrical charges which might be near it. If there were two corpuscles in the atom more than the number required for the most stable form, we can picture the atom as having two corpuscles free and the rest fixed. Similarly, if we had more than two extra corpuscles. Thus we may regard the atom as possessing 0, 1, 2, 3 corpuscles which are able to move about with more or less facility, and the free corpuscles will give to the atom the power of exerting attractions on electrical charges to an extent which depends on both the number of corpuscles and the freedom with which they can move about. On the theory to which I have alluded, the number of these "free" corpuscles determines the valency of the atom.

Now let us suppose that two such atoms come into such close connection that the corpuscles in the one exert considerable forces on those in the other. The system consisting of the two atoms will rearrange itself so as to get into a more stable form, if necessary, corpuscles passing from one atom to the other to enable it to do so. The greater stability, however, implies a loss of mobility; the free corpuscles have become parts of a more stable system, and have therefore lost to a greater or less extent their mobility. But with the mobility of the corpuscles goes their power of exerting forces on electrical charges, and thus the combination of the atoms diminishes to a great extent the attractions they exert outside them. Speaking generally, we may say that on this view the combination of atoms to form molecules, either of compounds or elements, fixes corpuscles which were previously mobile and converts the atoms from conductors of electricity into insulators with a small specific induction capacity.

FIG. 7.

I have brought these illustrations before you with the object of showing that we have now methods which are capable of dealing with much smaller quantities of matter than the methods now used by chemists, methods which are capable of detecting transient phases in the processes of chemical combination, and I am hopeful may be of service in throwing light on one of the most interesting and mysterious problems in either physics or chemistry—the nature of chemical combination.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—Mr. A. D. Darbishire has been appointed to the newly instituted lectureship in genetics, and will deliver a course of six lectures on heredity during the summer session, the course to be free to all matriculated students. Dr. W. G. Smith has been reappointed Combe lecturer in psychology. The executive committee of the Chiene portrait fund has resolved to hand to the University the balance of the fund (a sum of from 310*l.* to 320*l.*) for the foundation of a bronze medal, to be called the "Chiene medal in surgery."

M. TISSOT, an assistant in the Paris Museum of Natural History, has been appointed professor of physiology in the museum.

DR. D. FRASER HARRIS, lecturer on physiology in the University of Birmingham, has been appointed the Thompson lecturer in natural science for 1911–12 at the United Free Church College, Aberdeen.

SIR J. CAMERON LAMB, C.B., C.M.G., has been appointed to represent the Royal Society of Arts at the forthcoming

five hundredth anniversary of the foundation of the University of St. Andrews.

MR. R. NEWSTEAD, lecturer in economic entomology and parasitology in the Liverpool School of Tropical Medicine, has been appointed to the newly established Dutton memorial chair of entomology in the University of Liverpool.

THE Mathematical Society and the Society of Applied Physics of Göttingen have given 100,000 marks to a fund for the creation of an Institute of Mathematics in connection with the University of Göttingen. Two donations of 50,000 marks from manufacturing houses have also been received.

WE learn from *Science* that the Alabama legislature has made the University of Alabama an additional grant of 60,000*l.*, to be expended during the next four years for maintenance and new buildings. On his recent visit to Pittsburg, Mr. Carnegie presented the Carnegie Technical Schools with a valuable 725-acre tract of land that he had owned for some years, twenty-five miles up the Allegheny River from Pittsburg. It will be converted at once into an experimental station and engineering camp.

WE learn from the Journal of the Royal Society of Arts that a system of schools and stations to teach agriculture in the several States, in harmony with the plan for apprenticeship trade-schools, has recently been sanctioned by the Brazilian Government. At the head is to be a higher school of agriculture and veterinary surgery, situated at Rio de Janeiro. The school will give education fitting students for places as experts in the general extension of agricultural training. With the cooperation of the State Government, agricultural schools, experimental stations, model farms, and stock ranches will be established as soon as the general working out of the plans justifies such work. Elementary instruction in rural industries will be encouraged in schools for elementary education already established. By demonstrations at experimental stations and elsewhere it is intended to instruct farmers in the use of modern implements and methods necessary to success in farming.

THE Education (School and Continuation Class Attendance) Bill was presented to the House of Commons by Mr. Runciman on May 26. The principal objects of the Bill are to abolish the existing half-time system, to enable local education authorities to compel the attendance at continuation classes up to the age of sixteen of children who have ceased to attend a public elementary school, and, where this compulsion is not applied, to make fourteen the normal age for leaving school. At present a child under fourteen years of age can obtain exemption from school attendance in different ways, according to the district. These methods depend upon previous attendance at school, or proficiency, or a combination of the two. The Bill proposes that compulsory attendance at school up to the age of thirteen shall be universal, and not dependent upon local by-laws. Beyond thirteen years, under the Bill, every child must either continue to attend school up to the age of fourteen, or—where the principle of compulsion to attend continuation classes to the age of sixteen has been adopted in the locality—obtain special exemption from school attendance on the ground that he is entering beneficial employment, when he will, of course, attend the continuation school until the age of sixteen. An exception is made in the case of children beneficially employed in agriculture, for these may be specially exempted from school attendance at thirteen, even when there is no provision for compulsory attendance at continuation classes. If the Bill is passed, the half-time system disappears by which children employed during part of the day or week are compelled also to attend an ordinary elementary school for other parts of the day or week.

THE recently published report of the Apprenticeship and Skilled Employment Association, which deals with the work accomplished during 1910, is interesting reading. The object of the association is the promotion of the industrial training for boys and girls by apprenticeship and other methods, including arrangements for attendance at trade schools and at technical classes. The central office of the association is intended to bring all local agencies dealing with the skilled employment of boys and girls into cooperation with each other. It supplements, when necessary, the industrial information obtained by local committees; it encourages the formation of new committees; it arouses public interest in the objects of the association by organising conferences, and issues such literature as may be useful. The report shows that the association has been successful in maintaining cordial relations with the Board of Trade, the General Post Office, the London County Council, and other bodies concerned directly or indirectly with the objects of the association. It may be mentioned that the experiment referred to on previous occasions in these columns, of trying to find suitable employment for boys and girls who have hitherto been employed as laboratory monitors in secondary and higher grade schools, continues to receive the attention of the association. During the year under review, out of twenty-nine boys applying, fifteen have been placed by the association in appropriate situations. So far, the efforts to place the girl laboratory monitors have met with no success, although various firms—chiefly dyers and cleaners—have been applied to. The question of employing girls as laboratory attendants is, says the report, a doubtful one, and it would be well if the advisability of employing girls in this capacity were reconsidered. The offices of the association are at 36 and 37 Denison House, Vauxhall Bridge Road, S.W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society May 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—The Hon. C. A. **Parsons** and S. S. **Cook**: Experiments on the compression of liquids at high pressures. During the experiments on the behaviour of carbon under high pressures and temperatures, described in a paper by Mrs. C. A. Parsons, June 27, 1907, to the Royal Society, very considerable volumetric compressions were observed in the case of oils and other liquids. The present paper records some investigations into those compressibilities. The apparatus consists of a hydraulic press capable of exerting a maximum force of 2000 tons. Under the press is placed a massive block of gun steel, with a 4-inch hole and plunger of tool steel packed with a cup leather reinforced by a brass cup, which has been found to be satisfactory up to pressures of 40 tons per square inch, and quite tight for fluids. The estimation of the total friction by the method of the loop diagram, and the correction for the elasticity of the mould packings and ram by the method of replacing a known volume of the fluid by steel, are fully described, and the pressure in the mould is given by the water-gauge pressure on the rams of the press, plus the weight of the moving parts multiplied by the constants. The fall of temperature on sudden removal of pressure, and the curves for isothermal and adiabatic compression, are given for some fluids. From these data the internal work of the fluid is calculated for water, ether, and paraffin oil. In the preliminary experiments the pressure was carried up to 40 tons per square inch, but because no advantage was apparent and some inconvenience was involved, the pressure was limited to 4550 atmospheres, under which water is compressed to 87 per cent. of original bulk. The results as to compressibility are in close agreement with those of Amagat, so far as the latter were carried, *i.e.* 3000 atmospheres.—Prof. W. H. **Bragg** and H. L. **Porter**: Energy transformations of X-rays. There seems to be good reason to suppose that the energy of the secondary kathode ray comes from the energy of the primary X-ray. This leads to the "corpuscular" theory of the X-ray (and similarly of the γ ray). Each such ray must move without gradual change of form or energy until at last an atom through which it is passing causes the conversion of form, that is to say, the transformation to kathode-ray energy. On this view (1) the absorption of X-rays means simply the transformation of energy, and (2) the X-ray itself does not ionise at all. The pre-

sent paper describes experiments intended to test these deductions. The results show that in the cases considered the second deduction is verified, and the first also, when the test can be pushed to completeness. In some cases insufficient knowledge of the law of absorption of the kathode rays, and of other important processes, prevent the full application of the test, but it is satisfactory so far as it goes.—Prof. A. **Fowler** and the Hon. R. J. **Strutt**: Spectroscopic investigations in connection with the active modification of nitrogen. I.—Spectrum of the afterglow. (1) The paper gives a detailed account of the spectrum of the afterglow of pure nitrogen, with wave-length determinations of sufficient accuracy to indicate the series relationships of the various bands. (2) The characteristic bands of the afterglow in the red, yellow, and green are complex groups which have been found to be identical with some of the bands forming the sequence known as the first positive group of nitrogen. They represent a special development of three of the numerous series into which the first positive bands have been divided. (3) The second group of afterglow bands, extending from 4312 to 2503, corresponds with a group of faint bands which occur in the uncondensed discharge in air or nitrogen, and the third group is identical with the third positive group of nitrogen bands, as previously shown by Lewis. (4) The most characteristic feature of the condensed discharge which produces the afterglow is a series of seven complex bands, occupying the region 2904 to 2256, which have not previously been recorded as belonging to nitrogen. It is suggested that these should be designated the "fourth positive" group of nitrogen bands. (5) No afterglow is excited when the discharge is such as to give only the line spectrum of nitrogen.—C. **Cuthbertson** and Mrs. M. **Cuthbertson**: An optical method of measuring vapour pressures: vapour pressure and apparent superheating of solid bromine. The vapour pressures of solid bromine between $-80°$ C. and the melting point have been measured by counting the number of interference bands which pass across the field of a Jamin refractometer as the temperature of the solid is gradually raised. The vapour-pressure curve obtained agrees well with that observed by Ramsay and Young down to $-17°$ C. The behaviour of the vapour pressure near the melting point is remarkable, and suggests the inference that superheating of the solid occurs.—Dr. Frank **Horton**: The vacuum-tube spectra of mercury. Under certain conditions, mercury vapour may be made to give several different line spectra in which the number of lines appearing ranges from 5 in the simplest case (the yellows 5791, 5770, the green 5461, the blue 4916, and the violet 4359) to a very large number in the case of the "many-lined spectrum" first observed by Eder and Valenta. The observations were made directly by means of a direct wave-length reading spectroscope, and several new bright lines are recorded in the red and orange regions of the spectrum. The luminosity was excited in three different ways:—(1) by means of the discharge from a glowing lime kathode; (2) by an induction-coil discharge through the vapour at different pressures, and with different amounts of capacity in the circuit; (3) by means of the electrodeless ring discharge. Five distinct spectra were recognised, all of which may be obtained with the induction-coil discharge by suitably regulating the conditions. The glowing lime discharge gives one of the simplest spectra; the electrodeless ring discharge gives the spectrum containing most lines.—R. **Whiddington**: The production of characteristic Röntgen radiations. A characteristic radiation can usually only be excited when the velocity of the kathode rays within the X-ray tube supplying the primary rays exceeds a certain value, depending on the radiator. The value of this critical speed, v_c, has been accurately determined for the radiators Cr, Fe, Ni, Cu, Zn, Se; that for Al has been given in a previous paper. It appears that, for the radiators studied, v_c is proportional to the atomic weight of the emitting element, being very nearly 10^8 times the atomic weight. The potentials corresponding to these velocities range between 7320 volts and 15,400 volts. An interesting result obtained during the course of the investigation is that the energy emitted in the form of Röntgen radiation by a kathode particle when suddenly stopped is proportional to the fourth power of its velocity.

Linnean Society, May 4.—Dr. D. H. Scott, F.R.S., president, in the chair, afterwards Prof. Poulton, F.R.S., vice-president.—Rev. T. R. R. **Stebbing**: John Vaughan Thompson and his polyzoa, and on Vaunthompsonia, a genus of sympoda. In comparing the claims of polyzoa and bryozoa to be the name of a class, the paper submits the following propositions:—(1) A majority of writers use bryozoa. (2) As used by Thompson, *polyzoa* is a word in the singular number; as used by Busk and his followers, it is in the plural; therefore, as Busk candidly points out, the words are not synonymous. (3) For a class-name the plural is essential, and thereby Ehrenberg's bryozoa obtains priority. (4) *Polyzoa* in the singular was first used by Lesson, who gave the name to a genus of compound ascidians. (5) Thompson himself placed the genera and species in which he had observed "*Polyzoae*" in the class *Mollusca acephala.* (6) It was not Thompson, but Grant (in his observations on Flustræ) who first drew the distinction between these polyps and the hydroid polyps with which they had been confused. This again is pointed out by Busk. (7) As Waters long ago, and again recently, has insisted, Thompson meant by Polyzoa, not a class, but a polypide, a structural element in certain organisms. Possession of vertebræ distinguishes a codfish from a crab-fish and a shellfish, but no one would think of proposing Vertebra as a plural word for the name of a class or phylum. A supplementary notice vindicates Vaunthompsonia as the correct form for Bate's sympodan genus in opposition to Vauntompsonia of later introduction, and gives reasons for discarding the term cumacea in favour of sympoda.—Dr. F. E. **Fritsch**: Fresh-water algæ collected in the South Orkneys by Mr. R. N. Rudmose Brown. Comparison was made between the algal floras of the South Orkneys and South Georgia, and special attention was directed to the constituents of the "Yellow Snow."—Prof. Sydney J. **Hickson**: Polytrema and some allied genera. The discovery of some very large specimens of foraminifera belonging to the species described by Carter as *Polytrema cylindricum* in the material collected by Prof. Stanley Gardiner in the Indian Ocean led the author to make a careful examination of this and of other species attributed to the genus Polytrema. The result of this examination was to prove that the specimens usually labelled Polytrema in collections may belong to three quite distinct genera. *Polytrema cylindricum* of Carter is the type of a genus for which the generic name Sporadotrema is proposed. The specimen described by Carpenter under the name *Polytrema rubra* (Lamk.), and many other specimens that are labelled *Polytrema miniaceum* (Pallas) in collections belong to another genus, for which the generic name Homotrema is proposed. The specimens described by Merkel, Lister, and others under the name *Polytrema miniaceum* belong to a genus distinct from the other two, and for this it is proposed that the generic name Polytrema be retained. A description of the principal characters separating the three genera is given in the paper.—J. M. **Brown**: Observations on some new and little known British rhizopods.—R. **Shelford**: The British Museum collection of Blattidæ enclosed in amber.

British Psychological Society, May 6.—Prof. Carveth **Read**: The psychology of genius. The chief condition of genius is sensitiveness to analogy supported by extraordinary power of registering experiences, perhaps without consciously attending to them, in such a way that, although they cannot normally be reproduced, they influence by analogy future constructive or analytic processes.—Miss E. M. **Smith**: Some observations concerning colour vision in dogs.—W. H. **Winch**: Some new exercises in reasoning suitable for the mental diagnosis of school children.

Zoological Society, May 9.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Lieut.-Colonel Neville **Manders**: The phenomena of mimicry amongst butterflies in Bourbon, Mauritius, and Ceylon. The author had investigated the habits by observation and experiment of the insectivorous reptiles and birds of these islands, and had been unable to accept the view that their relations to butterflies were such as to be effective in producing Batesian or Müllerian mimicry.—R. I. **Pocock**, F.R.S.: The palatability of some British insects, with notes on

the significance of mimetic resemblances. At Prof. Poulton's request the author undertook in the summers of 1909 and 1910 to make a series of experiments in the gardens of the society to test the edibility of various British insects, most of which were sent to him, together with some slugs, by Dr. G. B. Longstaff. The insects comprised Lepidoptera, Coleoptera, Orthoptera, Hemiptera, Diptera, and Hymenoptera, and the most interesting of the experiments were those made with the bumble-bee (Bombus) and its mimetic fly (*Volucella bombylans*) to test the theory of mimicry. The Bombus proved to be unpalatable to nearly all birds. The birds would try them a varying number of times. When they had learnt their distastefulness by experience, they refused to touch them, and then when offered the Volucella refused that likewise. A considerable number of species of insectivorous birds were tested in this way, and always with the same result; and the one specimen of *Volucella bombylans* that did duty for some thirty or forty experiments went through the ordeal untouched.—Prof. G. C. **Bourne**, F.R.S.: The second portion of his paper on the morphology of the group Neritoidea of the aspidobranch gastropods, which dealt with the Helicinidæ. The author stated that this family was capable, by some unknown means, of wide dispersal across seas and oceans, and that the conditions most suitable to its existence were found in proximity to the sea. In describing the anatomy, the genus Alcadia was taken as the type, and the differences between it and the other genera were pointed out, but the species, and even the genera, of Helicinidæ were closely similar, anatomically, from whatever part of the world they came.—J. J. **Lister**, F.R.S.: The distribution in the Pacific of the avian family Megapodidæ.

Mathematical Society, May 11.—Dr. H. F. Baker, F.R.S., president, in the chair.—G. T. **Bennett**: The kinematical and geometrical theory of a deformable octahedron.—J. W. **Nicholson**: The scattering of light by a large conducting sphere (second paper).

Physical Society, May 12.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Sir G. **Greenhill** and Colonel R. L. **Hippisley**: Diagrams of stream lines past an elliptic cylinder.—J. T. **Morris** and T. H. **Langford**: The method of constant rate of change of flux as a standard for determining magnetisation curves of iron. The research described was instituted with the object of finding what differences there were between the magnetisation curves for a given sample of iron when determined (1) by the older methods in which the flux is changed suddenly, (2) by a method in which it is changed exceedingly slowly and at a uniform rate. The methods experimentally examined were:—(1) method of constant rate of change of flux; (2) "slow cyclic" hysteresis loops by method (1); (3) "step by step" magnetisation curve; (4) "step by step" hysteresis loops; (5) method of reversals"; (6) alternating-current magnetisation curve. Details are given of the theory and practical working of method (1). In this method the magnetising current is continuously increased through a primary winding by a specially designed resistance at such a varying rate as to maintain a constant voltage generated in a secondary winding. A certain amount of skill is required in operating the resistance, but an average experimenter may easily acquire this with a little practice. The complete change of the current occupied times varying from one up to some five minutes. Tables are given of the magnetisation curve determined by the six different methods at a number of values from **H** 0·3 up to 70·0, and of the permeability from **B** 500 up to 17,000. At low values of the magnetising force the uniformly varying flux method gives results of some 200 lines per square centimetre in excess of the older methods. As regards the time required for determinations by the various methods experimentally examined, ballistic methods are undoubtedly the most tedious. The alternating-current method (method 6) has considerable advantages in this respect, a full set of readings of magnetising current and induced voltage occupying a very short time. When, however, it is necessary to take oscillograms at various points in order to plot curves of form factors, the time required is enormously increased. The method of uniformly varying flux (method 1) is peculiarly adapted for use where time is a consideration, and at the same time a high degree of accuracy is desired. A complete magnetisation curve may be taken in a very few minutes, and the mean of many such curves obtained in, say, one hour, the iron being demagnetised between each test. The method of "uniformly varying flux" appears to possess advantages, both scientific and practical, over the older methods in use for the testing of ring samples of magnetic materials. It avoids difficulties due to eddy currents and magnetic viscosity, which effects are themselves due primarily to rapid or irregular changes of flux. Besides rapidity of experiment, it also has the advantage of accuracy of repetition under standard or predetermined conditions of magnetic change. The method is, therefore, commended for the carrying out of magnetic tests, especially where great accuracy under definitely known conditions of experiment are essential.

Royal Anthropological Institute, May 23.—Dr. A. C. Haddon in the chair.—S. H. **Warren**: The classification of the prehistoric remains of east Essex. The district of eastern Essex is formed of a plateau deeply trenched by river valleys. On the plateau, and also at lower levels, are numerous Palæolithic deposits. The paper deals in detail with the later prehistoric remains only. The river valleys were cut at a time when the land stood higher, relatively to the sea, than it stands to-day. As submergence set in, the lower reaches of the valleys were invaded by the sea, and they became partially silted up with tidal clay. Upon the former dry land surface, now buried beneath the tidal clay, large numbers of prehistoric remains have been found. These include polished axe-heads, knives, arrow-points, and other flint implements. Among the pottery, some remains of the "drinking-cup," or "beaker," have been found, and it is to this archæological stage that this buried prehistoric surface is referred. Beneath this surface, deposits of rain-wash are found which yield an earlier series of prehistoric remains. These are post-Palæolithic, as they include polished stone axes, barbed arrow-points, and pottery. The question of the position which these remains should occupy in the prehistoric succession was discussed. The advantage of using a sequence date scale, rather than a succession of epochs with indefinite and overlapping boundaries, was insisted upon.—Dr. A. **Keith**: A prehistoric skeleton. The skeleton, described in an appendix to the foregoing paper, belonged to the horizon of the buried surface. It was remarkably perfect, and was that of a woman of about twenty-five to thirty years of age. Although of small cranial capacity, it was of fairly high type. The skull inclined to the round-headed form, the index being 77·8. The stature, 5 feet 4 inches, or slightly less, the limb bones slender, the hands and feet small. It was buried in the contracted position. The body had been swathed in the tough roots of the sand-grass, while within the cavity of the body a considerable quantity of the seeds of the blackberry and the dog-rose was found. These were undoubtedly the remains of food.

CAMBRIDGE.

Philosophical Society, May 8.—Prof. Seward, F.R.S., vice-president, in the chair.—H. Hamshaw **Thomas**: The spores of some Jurassic ferns. A preliminary note recording the discovery in the estuarine shales of the Yorkshire coast of the spores and sporangia of *Coniopteris hymenophylloides* (Brongn) and *Todites Williamsoni* (Brongn). In the case of the former species, further evidence is afforded for the inclusion of this Jurassic type in the Cyatheaceæ, while the spores of Todites are shown to be almost identical with those of the recent *Todea barbara*.—C. E. **Moss**: A new species of Salicornia from Angola. The specimens on which this communication is based were collected by Welwitsch during his travels in Angola between 1853 and 1861, and are preserved in the British Museum (Natural History). By Mr. Hiern ("Catalogue of African Plants collected by Dr. Friedrich Welwitsch," iv., 1900, pp. 899–900), the plant is referred to *Arthrocnemum macrostachyum* (= *Salicornia glauca*). Welwitsch himself regarded it as a species new to science, wrote out a full description of it in Latin, and provisionally named it (in MSS.) *Arthrocnemum angolense*. There can be no doubt that Welwitsch's surmise was correct, as

the plant differs from all described species of Arthrocnemum and Salicornia in habit, colour, vegetative segments, flowers, and seeds. Moreover, *A. macrostachyum* is not known outside the Mediterranean region. As Arthrocnemum (Moquin-Tandon, Mon. Chen. Enum., 1840) is better regarded as a subgenus of Salicornia than as a separate genus, it is proposed to describe Welwitsch's Angolan plant under the name of *Salicornia angolensis*.—S. **Mangham**: The detection of maltose in the tissues of certain angiosperms. By the method of forming osazones *in situ* introduced by Senft in 1904, it is possible to distinguish between maltose and other plant sugars. The formation of maltose phenylosazone in definite crystalline masses closely associated with the phlœm of the vascular bundles in the midribs and petioles of several starch-forming plants, together with the occurrence in the sieve-tubes of a yellow semi-crystalline liquid like that from which the crystals arise, suggests that maltose is translocated as such in the sieve-tubes. It has been observed that while the distal portions of the sieve-tubes frequently contain only the yellow, syrupy liquid, this to some extent is replaced by definitely crystalline osazones [dextrose?] further down the sieve-tubes, as if in the course of translocation the maltose were hydrolysed.

MANCHESTER.

Literary and Philosophical Society, April 25.—Mr. Francis Jones, president, in the chair.—Dr. Henry **Wilde**: The periodic times of Saturn's rings. In the paper on the origin of Saturn's rings, read by the author last year, a new determination was made of the periodic times of the rings based on the commonly accepted distance of Mimas, 3·36 Saturnian units, from observations made by Herschel, and subsequently adopted by all astronomical writers. Recent observations of American astronomers have reduced the distance of Mimas to 3·16 units, with the consequent increase in the times of rotation of the rings. The difference between the older and later determinations is sufficiently large to induce the author to place on record the results computed from both observations and Kepler's third law. The later result shows for the outermost circumference of the outer ring a periodic time of 14h. 4m., and for the inner edge of the dusky ring a period of 5h. 45m. It is evident that the rings are ejectamenta from the interior of Saturn. The same conclusion may also be drawn with reference to the origin of the two satellites of Mars.—Dr. A. N. **Meldrum**: The development of the atomic theory: (7) the rival claims of William Higgins and John Dalton to the chemical theory. The resemblance between William Higgins's chemical theory, published in 1789, and John Dalton's, formed in 1803, is so close that there is no denying that Dalton was forestalled by Higgins. The closeness of the resemblance is accounted for by the fact that in their speculations Higgins and Dalton each took Newton's atomic theory as a starting point. Dalton's unquestionable merits in connection with the atomic theory are based, first, on his persistent efforts to bring the theory to bear in every direction both in physics and chemistry. He was the first to draw up a table of atomic weights. Again, the utmost credit is due to Dalton for his attempts, again and again renewed, to arouse the attention of scientific men to the value of the theory.

DUBLIN.

Royal Irish Academy, April 24.—Rev. Dr. J. P. Mahaffy, president, in the chair.—James **Murray**: Clare Island Survey—Arctiscoida. The author adopts this name instead of the better known Tardigrada, which is preoccupied. Thirty-three species were collected in the Clare Island district, of which five are described as new species—*Macrobiotus richtersii*, *M. scabrosus*, *M. hibernicus*, *Echiniscus militaris*, and *E. columinis*. In the list are several Canadian species hitherto unknown in Europe. *Echiniscoides sigismundi* is the first marine water-bear recorded from the British Isles.

PARIS.

Academy of Sciences, May 22.—M. Armand Gautier in the chair.—Pierre **Termier** and Jean **Boussac**: The existence, in the Ligurian Apennines to the north-west of Gênes, of a lateral passage of the crystallophyllian series, the so-called *schistes lustrés*.—A. **Perot** and Mlle. **Lindstedt**: The wave-length of the solar line b_2. The wave-length measurements of the magnesium line b_2 were obtained by the interference method previously used by Perot for one of the iron lines. The method has the great advantage of not making use of the terrestrial line, which cannot be produced under the same conditions of temperature, pressure, and density. If the centres of absorption of the line are animated by a centripetal movement in addition to their movement of rotation, the wave-lengths at different points would be of the same order as those actually found.—Léon **Autonne**: Certain commutative groups and pseudo-zeros of hypercomplex quantities.—L. **Creux**: The transformation of the movement of expansion into a movement of rotation by the development of the circle.—L. **Riéty**: The electromotive force produced by the flow of a solution of sulphate of copper through a capillary tube. A solution containing 1 per cent. of crystallised copper sulphate, when forced through a capillary tube under a pressure of 90 atmospheres, develops a difference of potential of about 0·03 volt. The potential is proportional to the difference of pressure between the two ends of the tube. For solutions containing between 0·2 and 2 per cent., the product of the conductivity by the potential difference reduced to one atmosphere is practically constant.—Georges **Claude**: Luminescent neon tubes. The use of an electromagnetic valve, proposed by Moore, for the automatic admission of fresh neon to a tube which has been in use for some time, although ingenious, the author regards as impracticable, and proposes a simpler alternative arrangement. The disappearance of the neon is directly connected with the vaporisation of the metal of the electrodes, and if the dimensions of these are increased, the vaporisation is correspondingly reduced, and the life of the tube increased.—Jean **Perrin**: New measurements of molecular magnitudes. Starting with an emulsion of gutta formed by the precipitation of an alcoholic solution by water, by a prolonged process of fractional centrifugation, particles of magnitudes between 0·5 μ and 2 μ were obtained. A further process of fractionation gave particles of a uniform size, 0·75 micron. The application of Einstein's formula to measurements of Brownian motion made with these particles gave for the electrostatic charge of the electron the value $4{\cdot}2\times10^{-10}$.—M. **Bancelin**: The viscosity of emulsions. In an emulsion formed of a liquid with a coefficient of viscosity k, containing small solid spheres in suspension of total volume ϕ, the coefficient of viscosity of the emulsion k', according to the calculations of Einstein, will be $k'=k(1+\phi)$. The author gives an experimental verification of this formula with uniform emulsions of gutta obtained by the methods of Jean Perrin, described in the preceding paper. In accordance with the Einstein theory, the increase of viscosity is found to be independent of the size of the particles, and depends only on the total volume of the particles per unit volume. Instead of the increase of viscosity, however, being proportional to $(1+\phi)$, it was found to be in the ratio $(1+2{\cdot}9\phi)$. A colloidal solution of methylene blue gave analogous results.—E. **Henriot**: The radiation from rubidium. As in the case of potassium, the greater portion of the radiation is distinct from the α rays. The 10 per cent. of the radiation which is more easily absorbed may be the α rays, but the examination of the salts did not admit of the proof of the existence of these rays by their radiations. As showing the atomicity of the phenomenon, various salts from different sources were examined, and there was found to be a good proportionality between the radiation and the percentage of rubidium.—Paul **Bary**: The mode of solution of colloidal materials.—Jacques **Duclaux**: The constitution of water. According to the conception of Röntgen, now generally admitted, water is a solution of ice in hydrol. Ice would have the formula $n(H_2O)$, and the accepted value for n is 3. Evidence is adduced to show that this is too low a value, 12 being a more probable value, if it be assumed that ice retains its density in solution.—Marcel **Delépine**: The pyridinepentachloro-iridites.—A. **Duffour**: Some new complex derivatives of iridium: iridotetrachloroxalates and tetrachloroiridites.—L. **Barthe**: Phosphates of uranyl and amines. Definite compounds of uranyl phosphate with methylamine,

ethylamine, and trimethylamine have been prepared and analysed.—M. **Hanriot** and A. **Kling**: The action of alkalis on the chloraloses.—James **Lavaux**: The action of methylene chloride upon *pp*-ditolylmethane.—P. **Lemoult**: Researches on derivatives of styrolene: rectification of some experimental errors. Some new determinations of the heats of combustion of some unsaturated hydrocarbons.—A. **de Schulten**: The determination of the crystallographic constants of some artificial apatites.—E. **Decrock**: Silica in the seminal tegument of Ravenala.—R. **Robinson**: Studies on the question of the determination of sex. Deficient secretion of the suprarenal glands appears to lead to an excess of female births. The use of adrenaline is suggested in cases where there are troubles in nutrition, excessive vomiting, &c.—Jules **Regnault**: Suprarenal optherapy in the vomiting of pregnancy. *Rôle* of the internal secretions in the determination of sex.—Henri **Piéron**: The determination of the period of establishment in mnemonic acquisitons.—F. **d'Herelle**: An epidemic of a bacterial nature ravaging the grasshoppers of Mexico.—L. **Mercier** and Ph. **Lasseur**: The experimental variation of the chromogenic power of a bacterium, *Bacillus chlororaphis*.—Ch. **Gravier**: Some incubating annelids arising from the second French Antarctic expedition.—P. **Achalme** and M. **Bresson**: The function of viscosity in the variations of the action of invertine according to the concentrations in saccharose. By taking into account the effect of viscosity of sugar solutions on diastatic action, the influence of concentration can be reduced to a simple and general law.—E. **Kayser**: The disease of cider known as *la graisse*.—Pierre **Thomas**: Some substances which accompany oxyhæmoglobin in its crystallisation.—G. **Vasseur**: The *facies* of the marine Stampian formation in the Aquitaine basin.—V. **Roussanof**: The goniatite fauna of the Lower Carboniferous and Upper Devonian found in Nova Zembla.

DIARY OF SOCIETIES.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.30.—Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis: Dr. R. Kennedy.—The Morphology of *Trypanosoma evansi* (Steel): Col. Sir D. Bruce, C.B., F.R.S.—The Pathogenic Agent in a Case of Human Trypanosomiasis in Nyasaland: H. S. Stannus and Dr. W. Yorke.—The Experimental Transmission of Goitre from Man to Animals: Capt. R. McCarrison.—The Action of Radium Radiations upon some of the Main Constituents of Normal Blood: Dr. Helen Chambers and Dr. S. Russ.—The Mechanism of Carbon Assimilation. Part III.: F. L. Usher and J. H. Priestley.—A Contribution to our Knowledge of the Protozoa of the Soil: T. Goodey.

ROYAL INSTITUTION, at 3.—Changes Effected by Light: T. Thorne Baker.

RÖNTGEN SOCIETY, at 8.15.—On a Possible Therapeutic Use of Strongly Ionised Air: C. E. S. Phillips.—The Photographic Investigation of the Forms assumed by the Brush Discharge in Air at Reduced Pressure: C. W. Raffety.

LINNEAN SOCIETY, at 8.—On the Occurrence of Amphidinium in Quantity at Port Erin: Prof. W. A. Herdman, F.R.S.—The Fauna of the Coal Measures: Dr. A. Smith Woodward, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—A Flame Test for the Estimation of Oxygen and Black-damp in Naked-light Mines: Dr. J. S. Haldane, F.R.S.—An Experiment on the Effect of Reversing the Main Air-current: James Bain and Dr. J. S. Haldane, F.R.S.—Notes on Contrivances Designed to Prevent Overwinding, with some Instances of their Failure: W. H. Pickering and Granville Poole.—The Otto-Hilgenstock Direct-recovery Process and its Application: Ernest Bury.

FRIDAY, JUNE 2.

ROYAL INSTITUTION, at 9.—Radiotelegraphy: G. Marconi.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

TUESDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—Charnwood Forest and its Fossil Landscape: Prof. W. W. Watts, F.R.S.

WEDNESDAY, JUNE 7.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Practical Progress in Wireless Telegraphy: T. Thorne Baker.

MATHEMATICAL SOCIETY, at 5.30.—On the Multiplication of Dirichlet's Series: G. H. Hardy.—On the Range of Borel's Method for the Summation of Series: G. H. Hardy and J. E. Littlewood.—On the Convergence of Fourier Series and of the Allied Series: Dr. W. H. Young.—On some Two-dimensional Problems in Electrostatics and Hydrodynamics: W. M. Page.

FRIDAY, JUNE 9.

ROYAL INSTITUTION, at 9.—Applications of Physical Chemistry to the Doctrine of Immunity: Prof. S. Arrhenius.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—The Lüders Lines on Mild Steel: W. Mason.—Exhibition of a Model illustrating the Passage of a Light Wave through Quartz: Dr. H. S. Allen.—Tables of Circular and Hyperbolic Functions for Complex Values of the Argument: A. Johnstone.—On the Measurement of Contact Differences of Potential: Prof. Anderson and J. G. Bowen.—Exhibition of Gyroscopic Apparatus: Sir G. Greenhill.—A New Method of Approximate Harmonic Analysis by Selected Ordinates: Prof. S. P. Thompson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Acmæa from Bombay and Notes on other Forms from that locality: E. A. Smith.—Description of Three New Species of Operculate Land Shells from Grand Cayman Island: H. B. Preston.—Further note on Preoccupied Molluscan Generic Names and Proposed New Names: G. K. Gude.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the District of the Bergen Arches: Dr. C. F. Kolderup.—The Rock Formation of the Bergen District: Horace W. Monckton.

SATURDAY, JUNE 10.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

ARISTOTELIAN SOCIETY (at Corpus Christi College, Oxford), at 9.—Real Being and the Object of Thought: G. F. Stout.

CONTENTS.

THURSDAY, JUNE 8, 1911.

THE "PERSONAL FACTOR" IN THE WAR AGAINST CONSUMPTION.

(1) *Pulmonary Tuberculosis and Sanatorium Treatment.* By Dr. C. Muthu. Pp. vi+201. (London: Baillière, Tindall and Cox, 1910.) Price 3*s*. 6*d*. net.

(2) *Conquering Consumption.* By Dr. Woods Hutchinson. Pp. 138. (London: Constable and Co., Ltd. Boston and New York: Houghton Mifflin Company, 1910.) Price 4*s*. 6*d*. net.

(1) SOME twenty years ago the sanatorium treatment of consumptive patients was but in its infancy, and, with the exception of Dr. Walther's disciples who had studied at Nordrach, there were few who understood the real inwardness of this method of treatment. The result was, necessarily perhaps, a somewhat hide-bound method, and although a certain proportion of patients did well, others, even those in the earlier stages of the disease, seemed to be unaffected, favourably, at any rate, by prolonged treatment. Indiscriminate over-feeding, irrational exercise, inattention to details, and imperfect understanding of the general principles upon which the sanatorium treatment is based were accountable for many of the failures.

During the last ten years a number of physicians, especially young men, have devoted themselves very thoroughly to the study of sanatorium and after sanatorium treatment, and we are now reaping, as the results of the observations and experience of these observers, an extensive literature, some of which has been embodied in what may be called the consumptives' liturgy. Amongst those who have written such text-books is Dr. C. Muthu, late physician to the Inglewood Sanatorium, Isle of Wight, and at present physician to the Mendip Hills Sanatorium, Wells, Somerset. Dr. Muthu, who is not only a physician but a philosopher, gives a record of ten years' observations and work in open-air sanatoria.

As regards the pathology and etiology of tuberculosis, he has here written many things with which certain, probably the majority of, pathologists and physicians will disagree. This, no doubt, arises from the fact that Dr. Muthu looks at the question from the point of view of his patient, and we may accept it that from the point of view of treatment what is lost thereby is perhaps more than gained in another direction. One gathers from a perusal of this work that Dr. Muthu looks upon the successful treatment of pulmonary tuberculosis as being possible only when an intimate partnership and cooperative movement between physician and patient can be agreed upon and carried out. If the will of the patient be strong the firmness of the doctor is not so important a factor, but in the case of the inexperienced and vacillating patient the personality of the physician and his power of dominating his patient come to be of prime importance. The patient must be lifted out of his diseased condition, not only as regards body, but as regards mind. He must not dwell upon its course but upon its cure.

The keynote as to Dr. Muthu's ideas on the pathology of the disease is given in a statement put in opposition to von Ziemssen's dictum, "no tubercle bacilli, no tuberculosis," Dr. Muthu contending that it will be nearer the truth to say, "no soil, no tuberculosis," which one supposes should really read, "no suitable soil, no tuberculosis." Dr. Muthu's own statement is perhaps considerably stronger than he really wishes those who read his book to accept, for it is only fair to him to state that he still appears to have some belief in von Ziemssen's dictum. It is, however, the function and the appropriate function, of the sanatorium physician to preach the doctrine that the soil much more than the seed controls the disease, for, after all, it is the cure of the patient that he has to effect. One cannot help feeling, however, that it is a dangerous doctrine to preach that pulmonary tuberculosis is not a contagious disease. That the infective material takes long to manifest its presence all will accept, that it is not so infective as the ordinary zymotic diseases may also be taken for granted; but that it is infective, and, under certain conditions, highly infective, should never be ignored. However, those who read the chapters on the predisposing factors, on early diagnosis, and on the prognosis of tuberculosis will be interested whether they agree with the author or not.

When we come to the principles of open-air treatment we are in hearty accordance with almost every word Dr. Muthu writes. His experience is wide, he has entered into his work with enthusiasm, and apparently has recorded his results accurately. The special chapters on treatment are of interest rather to the medical profession than to the general public, and their value can only be fully appreciated by the medical man, as their complete understanding involves a knowledge not usually acquired by a layman. Dr. Muthu deals with the social aspect of tuberculosis in the third part of his work, and we can thoroughly recommend this portion to the consideration of all who take an interest in the welfare of their fellows. Dr. Muthu evidently feels deeply, and he certainly expresses himself strongly and clearly. Some may not agree with him on all that he writes, but here again, whether they agree with him or not, they will be interested and often enlightened. The book is well printed and the illustrations are excellent.

(2) In Dr. Woods Hutchinson's work we have an original and hopeful statement of what the Americans call "a difficult proposition." Dr. Hutchinson starts out on the assumption that man is "the toughest, the most resourceful, the most ferocious and dangerous animal that walks upon the face of the globe," and he thinks that we have not yet added bacteria to our conquests simply because we did not know of their existence until about half a century ago. Now he considers that this conquest is only a question of time, especially as the harmful bacteria form such a relatively small proportion of the known microbial organisms. Dr. Woods Hutchinson is a great believer in the tubercle bacillus as the cause of tuberculosis, and he considers that as a cause of

the disease it may be taken into the human system in various ways—in the food we take, the air we breathe, in the dust of the room, of the street, by flies, dirty fingers, filthy garments, and in a dozen other ways in which excreta and dirt may be spread. He considers that eight-tenths of all civilised people have had tuberculosis and have recovered from it without knowing anything at all about it.

In spite of all this, after describing in very popular language tuberculosis of various types, he states his belief that if we could put a stop to the dissemination of the tubercle bacillus we could put an end not only to pulmonary consumption, but could diminish our cripples by two-thirds, cases of scrofula by three-fourths, the fatal convulsions of childhood by a half, and eliminate a very large proportion of the fatal bowel diseases that occur in childhood. His optimism again comes forward when he considers Osler's statement that "we to-day run rather less than half the risk of dying of consumption that our grandfathers did and barely three-fourths of the risk that our parents did."

Dr. Hutchinson now and again drifts into what may be called Dooleyisms, which have a distinctly original flavour about them, and certainly tend to amuse, and, at the same time, to give us "furiously to think." As in the following:—

"If the rich had more sense and the poor more money, and both more public spirit, consumption would soon be a thing of the past. And it would be only one of many evils which would disappear in the process."

Again, when speaking of fresh air, he says:—

"Like other necessities of existence, it goes with the land, somebody else is going to get too little air, not to mention food and other incidentals. This isn't socialism—it's sanitary science. . . . It costs money to have plenty of fresh air to eat, even though the air is free . . . the one thing which no intelligent, civilised community can afford under any circumstances, is to allow any section, or class of it, to grow up without sufficient food to eat, air to breathe, and fuel to burn. . . . Wipe out the conditions which create consumption, and you will at the same stroke abolish half our crime and two-thirds of our pauperism!"

Dr. Hutchinson, after giving his message of hope describing the bacillus as the enemy, the weapons of the war to be waged against him, gives chapters on "Fresh air and how to get it," "Sunlight: the real golden touch," "Food, the greatest foe of consumption," "Work and rest: intelligent idleness," "The camp and the country," "Cash and consumption," "Climate and health," and "Specifications for the open-air treatment at home."

Speaking of the open-air treatment of consumption and camp-life, he says:—

"The cure of consumption is not a drug, or an operation, or a magic method of any sort. It is a *life* that must be lived twenty-three hours and sixty minutes out of the twenty-four, and seventy years out of your threescore and ten. You cannot learn it properly by being told about it, or lectured about it, or advised about it ever so wisely—you must live it."

Referring to the economic aspect of the question, under the heading "Cash and Consumption," the author believes that the community should provide the means for the worker to recover from his tuberculosis, and he contends that it can very well afford to do so, as thereby it escapes supporting his widow and educating his orphan children. It is on this basis that he speaks of poverty as the most expensive thing in the world for any community when quoting the tables of Korosi, which show that of each 10,000 well-to-do persons only forty die annually of consumption; of the same number of moderately well-to-do, 62·7; of poor, 77; and of paupers, 97. He maintains that there is a sound biological basis for our desire to be rich, for he points out that by becoming so "we reduce our chances of dying from tuberculosis fifty per cent."

There is good, sound, common-sense in the chapter on climate and health, which contains the following statement:—

"If anyone goes South to avoid the trouble of ventilating his bedroom properly, or taking sufficiently vigorous exercise in the open air to get up a glow and defy the frost, he is doing himself harm rather than good."

Wherever you go, the author says, go to a place where you can be comfortable, where you can get plenty of good and cheap food, where you can live in the open air without discomfort, where you will not be overworked, and where you can carry out to the full all the lessons learnt in the sanatorium. We have enjoyed reading Dr. Woods Hutchinson's book, and we can recommend it to all who like common-sense and can appreciate the writing of a man who knows his own mind concerning the subject with which he is dealing.

PROGRESS IN GIRLS' EDUCATION.

Public Schools for Girls: a Series of Papers on their History, Aims, and Schemes of Study, by Members of the Association of Headmistresses. Edited by Sara A. Burstall and M. A. Douglas. Pp. xv+302. (London: Longmans, Green, and Co., 1911.) Price 4*s*. 6*d*.

THIS is a book calculated to rejoice the heart of an educational worker, not so much for the wisdom it contains as for the evidence it affords of the spirit animating the educational policy of our leading English schools for girls. Here we have twenty-four essays relating to the subjects of girls' education, written by experienced headmistresses, who one and all seem to have a real zeal for their work, and a humble-minded desire to find the best way of doing it. There is a sense of sincerity, earnestness, and warmth in the essays that is highly pleasing, and a willingness to look at new proposals and plans that contrasts most favourably with the self-confidence, and subacid raillery sometimes affected by the high-placed pedagogue.

The essays are the outcome of a suggestion made by Mrs. Woodhouse, when president of the Association of Head Mistresses for 1907–9, and they are edited by her successor, Miss Burstall, and Miss Douglas, chairman of the curricula subcommittee.

They comprise a chapter dealing with the history of the development of public secondary schools for girls, a series of papers describing the present manner of dealing with the various school subjects, a paper on examinations, and papers on the general aims and ideals in education and suggestions as to possible reforms. The subject of discipline is deliberately omitted.

It will be understood from the foregoing that the amount of material presented affords abundant opportunities for comment and criticism, but the present notice must be restricted to one or two topics.

In the first place, it is noteworthy that in this presentation of views we find distinct evidence of an increasing differentiation between the education of girls and the education of boys. This, in a sense, is nothing new. Long ago there was a differentiation, inasmuch as whilst boys were being substantially taught, girls were being scarcely taught at all. But the first onset of the girls' high-school movement tended to an equalisation, both in quality and quantity, and doubtless there are still a good many people who do not admit that there is good reason for much difference.

The question involved is really one of great importance, both as regards girls and boys. Is a secondary school to be regarded chiefly as preparatory to a university or as a place where formal education is for most people ended? If the destiny of the pupils is assumed to be the university, where, up to now, the professional studies of men and women have been undifferentiated, there does not seem to be much reason for difference between girls' schools and boys' schools, and in both cases the teaching will be on purely academic lines. But surely if we think of the vast majority of pupils, we must realise that this assumption is wholly unwarranted, and we are thrown back on the inquiry—should not our main object in girls' schools be to frame a curriculum which at the end will equip girls, in the fullest degree possible within a school, for the unprofessional life that follows?

If this question is answered in the affirmative, it can scarcely be denied that there is room for distinctive features in the curricula of girls' schools. Whatever happens in connection with what is called the feminist movement, it can scarcely be doubted that for a long time to come the vast majority of women will be concerned with the administration of the home, and it would seem natural that this should be in the minds of those who have to consider the curricula. That this is now much more the case than it was twenty years ago is one of the most gratifying inferences to be drawn from the volume before us, and it is to be hoped that, notwithstanding the deep-seated belief which we profess in what are called disciplinary and humanising studies, our headmistresses may have the courage to specialise studies and equip their girls for women's work so far as it can be properly done in school.

The teaching of science to girls is at present receiving a good deal of attention. The subject is dealt with in the present volume by the able and experienced hand of Mrs. Bryant, and incidentally in home science by Miss Faithfull, and in home arts by Miss Gilliland.

"The prime condition to be fulfilled in a school scheme of natural science study is," according to Mrs. Bryant, "that it shall lend itself with certainty and ease to develop in the immature but plastic mind of average ability this *scientific attitude* of alert *individual inquiry*." For this "the subject-matter should be at each stage as attractive as possible, in the sense of stimulus to inquiry. . . the problems raised by the subject under discussion should not be too difficult for the learner's own powers of intellectual inquiry. . . . So far as possible the natural practical interests of the learners should be enlisted as a powerful additional stimulus to scientific motive."

No one will be likely to find fault with this clear and reasonable doctrine.

I may perhaps be permitted here to fall into the first person and to state that for a long time past I have been endeavouring to assist in making school science for girls comply a little more fully than has been the case with Mrs. Bryant's third requirement, viz., that it shall appeal to the natural practical interest of the learners. In doing this I have been brought into conflict with those who are alarmed for the "purity" of science teaching, and I have been suspected of a desire to introduce a sort of soft and effeminate subject which lacks all the elements of logic and discipline, so dear to the stern educationist. As a matter of fact, my aim has been nothing more or less than to imbue the science teaching in girls' schools with as much illustration from everyday topics, and especially topics of the household, as will give it a living interest and make it a more human, more useful, and more abiding possession. I state it, not as an opinion, but as a fact of experience, that the average science graduate, male or female, coming from an ordinary university course, is extraordinarily ignorant of some of the very simplest applications of science in relation to daily life, and that there is a considerable region of facts, both in physics and chemistry, lying outside the conventional "subject" as understood by degree artists in universities, which it behoves every reasonable school science-teacher to explore. I am not fond of the term domestic science, which rather curiously has been often used as synonymous with the arts of the cook and launderer, but that the principles and discipline of elementary physical science can be inculcated with a large accompaniment of topics and examples relating to the household arts I am perfectly satisfied, and I shall not readily be deterred from advocating this at some sacrifice of Atwood's machine and the oxides of nitrogen.

The question of the teaching of practical household arts in relation to girls' schools is admirably dealt with by Miss Gilliland, but a discussion of this subject and many others must be forgone for lack of space. The essay on examinations by Miss Gadesden deserves a special word of praise. We can, in conclusion, warmly congratulate Miss Burstall and Miss Douglas upon having brought to publication a collection of essays which does great honour to those who are directing the momentous work of educating our future rulers.

A. SMITHELLS.

MODERN GAS MANUFACTURE.

A Text-Book of Gas Manufacture for Students. By J. Hornby. Sixth edition, revised and enlarged. Pp. xi+423. (London: G. Bell and Sons, Ltd., 1911.) Price 7s. 6d. net.

THE fact that a sixth edition of Mr. Hornby's text-book was needed is the most convincing proof of its excellence, more especially as the readers to whom it appeals are necessarily limited in number, and other text-books on the subject exist.

The many alterations and advances which have taken place in gas manufacture during the past ten years have rendered it imperative to remodel the book so as to deal with the various types of vertical retort which are being introduced, and the use of increased charges for horizontals, which are found to give substantial improvement in the quantity and quality of both gas and tar.

The author disclaims any intention of making the book an exhaustive treatise on the subject, but in point of fact he so nearly attains this level that it is a pity he has not gone a little more fully into the theoretical aspect of carbonisation as gleaned from his own experience, rather than to rely on quotations from the work of others, which, although in most part excellent, sometimes give a wrong impression.

For instance, in speaking of the effect of distillation at low temperature, he quotes a paragraph from Dr. Lunge's work on "Coal Tar and Ammonia," to the effect that amongst the liquid, watery products "acetic acid is paramount," which, although true to a certain extent of the products obtained from lignite and peat, gives a wrong impression of the liquor obtained at low temperature from an ordinary gas coal.

After a brief general sketch of the usual procedure in a gas works, the author deals in the first chapter with the formation and general characteristics of the various classes of coal, and in discussing the conversion of vegetable deposits into coal, represents the complete reaction of fermentation and decay on cellulese by the beautifully simple equation,

$$2(C_6H_{10}O_5)=5CO_2+5CH_4+C_2,$$

which certainly does not take into account the feelings of the supporters of any dehydration theories. In discussing the caking coals, it would be worth while in a future edition to mention at any rate the influence of the percentage of oxygen on the gas yield and coking properties of various coals.

In the second chapter the wide subject of carbonisation is attacked, and here the description of the gaseous products of distillation due to primary and secondary actions are not quite in accord with the more modern views on the subject, but the remainder of this and the next chapter are very well done, and the reader is given next a section on labour-saving appliances, amongst which inclined and vertical retort settings are dealt with.

The diagrams of the Dessau, Woodall-Duckham, and Glover-West retorts are excellent, and it is a pity that the author has not dealt more fully with the relative advantages and drawbacks of these systems. There is but little doubt that the continuous systems of carbonisation as represented by the two latter retorts gives the nearest approach to a uniform treatment of coal that is to be found, and that when the general arrangements have been perfected by experience they will show themselves to be far superior to their Continental forerunner, the intermittent Dessau retort.

The author's treatment of the modern practice of filling the retorts with the charge so as to leave no space at the top of the retort, and extending the period of carbonisation is insufficient, and the two reasons which he gives for the improved results obtained are not nearly so important as that the mass of coal provides a cool and easy escape for the hydrocarbon and other gases distilling from the portions in contact with the hot walls, and so prevents the destruction of valuable illuminants.

In this part of the work also some notice ought to be taken of Mr. Glover's Norwich chamber retorts, which for the same reason give excellent results.

It would have been of great advantage to the work if the author had compiled with care a table contrasting the results obtained by the various methods of carbonisation from the horizontal retort with small charges and high heats to the latest types of sloper chamber ovens.

In the appendix on the "Distillation of Tar," the author gives the specific gravity of ordinary tar as ranging from 1·12 to 1·16. Is this a relic of the days when the gas manager was content with 10,000 cubic feet of gas per ton of coal, or is it an up-to-date figure from the vertical retorts and modern processes? Has the author never come across that tar, which a large proportion of our gasworks are making, in which, owing to the degree to which the temperature has been pushed to obtain a large yield of gas, the specific gravity has been raised to 1·2 and above, and the value reduced almost to nil?

Perhaps the most serious fault that can be found with this text-book is that little or no attention is paid to the subject of the thermal value of gas. The day is rapidly approaching when illuminating value will be superseded by calorific value as the test for the quality of gas, when the calorie and thermal unit will be as important to the gas manager as the candle standard is now, and a text-book for the rising generation of gas engineers should certainly deal in full with the subject of how best to transfer the greatest heat value from the coal to the gas.

THE DELINEATION OF THE EARTH'S SURFACE.

Maps and Map-making. By E. A. Reeves. Pp. xiii+145. (London: Royal Geographical Society, 1910.) Price 6s. net.

THE course of instruction in surveying and map-making offered to students and travellers by the Royal Geographical Society is justly esteemed for its useful and practical character. A book on this subject by Mr. Reeves, the map curator of the society, who has for many years carried out the instruction. and under whose direction the system of teaching has

undergone continuous and marked improvement, is certain of a cordial welcome.

We may at once state that the book is no other than it purports to be—a reprint of three lectures, the first on instruments, the second on survey methods, and the third on maps and map-making. It is in no sense a text-book on the science of surveying. It is, for example, not the sort of book that the practical surveyor would take into the field, nor would it be of much value to the student who has passed the elementary stage.

Its true function, we take it, is identical with that of a lecture, not to instruct, but rather to stimulate curiosity, not so much to teach as to show that there are things worth learning. A book of this class has a tendency to fall into a difficult category, being too technical for the ordinary reader and too simple for the expert. At the same time, we may frankly recognise that as regards this particular subject there are a large number of persons—travellers, officers, and officials, whose duties take them into the uncharted regions of the world—to whom a little knowledge of survey methods is a valuable acquisition but who have no desire or capacity to prosecute their studies further.

To these and to all others who desire a general acquaintance with a science which must always remain of great practical importance and of considerable human interest, we can cordially recommend Mr. Reeves's book.

The first chapter, dealing with the history and development of surveying instruments, profusely furnished with illustrations, as indeed is the whole book, will be found full of curious information. The treatment of modern instruments is perhaps too compressed to be thoroughly satisfactory and has a tendency to degenerate into a mere catalogue, wherein the various instruments are briefly described, but no adequate attempt is made to estimate their relative merits or defects. Thus the prismatic sextant is mentioned as an "improvement" on the ordinary form without a hint that, as a matter of fact, it was found to be no improvement, and has passed entirely out of use.

The book is well printed and misprints are not common. We scarcely know whether the spelling *geodecist* (p. 24) is intentional; if so, we must enter a protest against it.

The specimen maps are reproduced with the uniform excellence of style that we are accustomed to in the R.G.S. publications.

In conclusion we may direct attention to the map on p. 131, showing relief by "stereoscopic" colouring, *i.e.* a system wherein the varying altitudes are shown by an ordered sequence of spectrum colours, the high ground red and thence descending through greens and yellows to a blue sea. The effect of relief on such a map is very good. The eye naturally adjusts itself as in viewing near and far objects so that the tops of the hills appear nearest and the bottoms of the valleys farthest from the observer. A neglect of this principle of spectrum colours is a marked defect of the recently published half-inch Ordnance Survey map of England.

E. H. H.

MATHEMATICAL TEXT-BOOKS.

(1) *Elements of Plane and Spherical Trigonometry.* By Prof. D. A. Rothrock. Pp. xi+147+xiv+99. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* net.

(2) *Homogeneous Coordinates for Use in Colleges and Schools.* By Dr. W. P. Milne. Pp. xii+164. (London: E. Arnold, 1910.) Price 5*s.* net.

(3) *A Geometry for Schools.* By F. W. Sanderson and G. W. Brewster. Pp. x+336. (Cambridge: University Press, 1910). Price 3*s.*

(4) *Analytic Geometry.* By Prof. N. C. Riggs. Pp. xi+294. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* net.

(1) THIS volume contains a fairly through treatment of the numerical aspects of plane and spherical trigonometry. In addition to this, a certain amount of attention is directed to elementary identity work, and some indication is given of the higher analytical developments of the subject, based on Demoivre's theorem, in the concluding chapter of the first part of the book. It is unfortunate that the symbol $e^{i\theta}$ is regarded as equivalent to $\exp(i\theta)$. This is the source of much error in the minds of students, and from the earliest stage it is most desirable to emphasise the distinction between the two forms. With this exception, the mode of presentation is excellent. There are numerous exercises and problems, but at present no answers are given. This is a serious omission, and it should be rectified in a new edition. Five-figure tables of logarithms and trigonometric functions are appended to the book.

(2) The utility of homogeneous coordinates when carefully employed, is undeniable. It so often happens that their properties are sketched in a brief chapter at the end of treatises on Cartesian methods, thus leading the reader to believe that the subject is one of small value and importance. It is, of course, a misuse of this instrument to apply it to metrical results, except in very special circumstances; but its application to properties of a descriptive character is particularly instructive and illuminating. The present volume contains, in a remarkably small compass, a comprehensive account of the subject, treated in exactly the right way. Its wealth of detail will be invaluable to the teacher, who will probably prefer to make selections for his pupils. The correspondence between point and line coordinates is worked out in a thorough fashion, and the part played by ideal and imaginary elements is clearly indicated. Such work as this is well within the range of the scholarship class in secondary schools, and it arouses keen interest, mainly because analysis is very properly subservient to principle. There is an admirable collection of examples. We wish the book all the success it unquestionably deserves.

(3) The plan of this book agrees to a large extent with the recommendations made in the Board of Education circular on the teaching of geometry. The proofs of the fundamental congruence and parallel theorems occupy a subordinate position, thus making it possible for the student to pass rapidly over the

initial stages and advance quickly to simple rider work. There are four main sections in the book; each of these starts with an experimental investigation and ends with the theoretical treatment of the corresponding theorems. There are abundant numerical examples, but some teachers will consider that the supply of riders is inadequate. An excellent innovation is the insertion of circle properties before areas are dealt with. This provides such an excellent field of simple and interesting riders that it is surprising that the Euclidean order has been followed so long. The last section contains as many of the theorems on ratios as are usually given in elementary text-books, the numerical examples, illustrating the use of proportion, are particularly good.

(4) The analytical geometry of the conic is treated in this volume in less detail than is usual in most text-books. For practical purposes, it is far more important for the student to acquire a correct appreciation of the principles which obtain for curves of any degree, and to master the use of infinitesimal methods. The author has therefore employed the calculus freely and applied it both to plane and skew curves and simple surfaces. The examples have been chosen rather to elucidate principles than to test analytical dexterity. The book may be used with confidence by engineering students, with whose needs it is primarily concerned.

SCIENCE AND SPECULATION.

The World of Life: a Manifestation of Creative Power, Directive Mind, and Ultimate Purpose. By Dr. A. R. Wallace, F.R.S. Pp. xvi+408. (London: Chapman and Hall, Ltd., 1910.) Price 12*s*. 6*d*. net.

THE appearance of a new book written by the veteran naturalist in his eighty-eighth year cannot fail to arouse the interest of a wide circle of readers. The work may indeed be regarded as a recapitulation of the opinions on a great variety of topics which, during a long and active literary career, extending over more than fifty years, Dr. Alfred Russel Wallace has put forth in a number of memoirs, books, and magazine articles. But to regard the work as a mere summary of the results of former labours would be to do a great injustice to its author; for there is scarcely a subject referred to in it, in which fresh facts, novel lines of reasoning, or suggestive conclusions are not presented for our consideration.

The book naturally divides itself into two portions, which are of very diverse character and unequal value and importance. As regards the first part, we must state at once that the space at our disposal is altogether insufficient to enumerate—much less to discuss—the numerous interesting problems suggested in it.

After a first chapter, devoted to a somewhat academical discussion of the nature and origin of life, we have five chapters treating on the subject with which Dr. Wallace's name will always be so honourably associated—the distribution of plants and animals. Readers familiar with the author's great work on this subject, and with his "Island Life," will be surprised and delighted to find how many novel facts and lines of treatment have suggested themselves to the author since the publication of his earlier works. Among many interesting discussions in this part of the book we may specially instance the contrasts pointed out between the more uniform floras of temperate climes and the richly diversified floras of tropical lands. These latter are shown in many cases to be in great danger of extinction through human agencies, and the interesting suggestion is made that the British Government might follow the example of the Dutch in Java, by establishing small forest reserves in our tropical colonies; such reserves, Dr. Wallace points out, need not be of anything like the extent of the animal reservations of North America and Africa, for, owing to the crowded and diversified nature of all parts of a tropical forest, small areas of even a square mile would be sufficient for the purpose.

Later chapters devoted to illustrations, extensions, and new applications of the theory of natural selection cannot fail to arrest the attention of all naturalists; we may especially refer to the discussion of "recognition marks," and those on bird life, bird migration and extinction, and the relations of bird to insect life. We may note that even when the author feels compelled to express dissent from the views of Darwin—as in his ideas concerning the origin of man's intellectual and moral faculties—we find his loyalty and devotion to his old friend and fellow-worker displayed as conspicuously as ever.

The three chapters on the geological record, well illustrated as they are by wood-cuts drawn from various sources, abound with interesting observations. We may instance his development of the ideas put forward by Dr. Smith Woodward, in an address to the British Association, concerning the tendency of groups of animals in the periods before their final extinction to run into extravagant and sometimes *bizarre* forms. This is illustrated in the case of the trilobites and ammonites.

Later chapters on the relations of the chemical elements to vital agencies, on the "mystery of the cell," on the parts played by plants, animals, and man respectively in the economy of nature, are eloquent and illuminating; but it is unfortunate that the author is never able to avoid the pitfalls of teleological speculation. This tendency is still more strikingly manifested when the author proceeds to discuss such questions as the existence of pain in the lower animals, of the non-justifiability of vivisection, of the remedies for the overcrowding of cities, and similar problems of the day. On all these and similar questions Dr. Wallace writes very confidently, sometimes intruding his speculative opinions in the midst of the treatment of purely scientific questions.

Most of the author's scientific friends—and they are very numerous—will feel regret that these and similar discussions were not reserved for a separate volume. We are all familiar, from reading his "Man's Place in the Universe," and his autobiographical work—"My Life"—with the author's peculiar views on extra-scientific, social, and political questions. Some of these tendencies to unbridled speculation seem to have reached an extreme limit in the twilight of a noble life, as when it is gravely suggested to sub-

stitute for the idea of a single Creator, orders of angelic beings, each charged with the task of originating and exercising supervision and control over special evolutionary processes! Everyone must feel how incongruous are such incursions into the realms of the unknown and the unknowable with the really valuable and suggestive discussions of the first part of the book. But however much we may regret the intrusion by the author of these wild speculations, and greatly as we may dissent from his social and political panaceas, as hopelessly impracticable, we all recognise that they are inspired by the author's love of humanity and all living things, by a desire to ameliorate the sorrows and sufferings he sees around him, and by a hope—ill-founded though it may be—that such teachings may be of service to his fellow-men.

NATIVES OF THE ARGENTINE REPUBLIC.

Los Aborigenes de la República Argentina. Manual adaptado á los programas de las Escuelas Primarias, Colegios Nacionales y Escuelas Normales. By Prof. F. F. Outes and Prof. C. Bruch. Pp. 149. (Buenos Aires: Angel Estrada y Cia., 1910.)

THIS neat little book, well printed and illustrated, far surpasses its modest subtitle: a manual adapted to the teaching in primary and secondary schools. It is really a condensed account of what is known of the natives of the Argentine Republic, of those who are quite prehistoric, those who were found at the time of the conquest by the Spaniards, and those who "still survive precariously in some far-off districts."

A rapid survey of the earth's history as told by the sedimentary strata and their leading fossils is made the occasion for explaining the meaning of the many indispensable technical terms. Since much of the evidence of the existence of prehistoric man rests upon his primitive implements, the theory of artificially chipped stones is explained and illustrated, and how, at least in Europe, the evolution through polished and carved implements of stone to those of metal can be traced. A roll-call of scientific work in Argentina, from Pigafetta, Magellan's companion in 1520, to the Princeton University expedition, concludes this introduction of twenty-eight pages.

The palæontological account is greatly helped by a coloured diagram. Besides the mystical Tetraprothomo, the pliocene Monte hermoso level has yielded pieces of rock which enthusiasts have taken for examples of intentionally fire-baked clay, whilst others refer their condition to volcanic action. In short, the earliest undoubted human remains and traces date from the Enseñada Loess, lowest pleistocene. The *Homo pampeanus*, of the early American type, seems to have used the carapace of the contemporary Glyptodons for shelter. Post-pampean man was clearly neolithic, and he continued in this state until his discovery by the Spaniards, with the sole exception of the Diaquita in the north-western mountains, which had advanced to the use of bronze. These interesting people are described in the second chapter.

To facilitate the account of the various tribes, each chapter has a little map, and stress is laid upon the prevailing climate, as influencing man through the fauna and flora. Each chapter begins with a description of the physical aspect of the respective district, whether forest, mountain, or plain, with frequent photographs; the tribes are grouped as much as possible according to their relationship. Each group, or tribe, or race, is tersely characterised physically; as a linguistic point the personal pronouns have been selected. Sociologically: the kind of food and how it is prepared, especial attention being paid to the mode of kindling of fire. Then follow the kind of shelter, dress, ornamentation, dances, creeds, and superstitions, family and funeral rites, weapons, and wars. To each chapter is attached a carefully selected and apparently well-nigh exhaustive bibliography, and 146 illustrations, comprising maps, scenery, implements, pictographs, and portraits enhance the text, which in a small compass manages to impart an astonishing amount of information.

OUR BOOK SHELF.

Solectrics: a Theory Explaining the Causes of Tempests, Seismic and Volcanic Disturbances, and how to Calculate their Time and Place. By Alfred J. Cooper. Pp. iv+100; illustrated by over 100 diagrams. (London: J. D. Potter, 1910.) Price 10s.

THE "solectric theory" postulates a force which in some sense corresponds to the sun's radiant energy, giving rise to light, heat, chemical action, and magnetism, but the author also inserts gravity and vital force. Having introduced such a force, the author is able to explain the rotation of the earth, the obliquity of the ecliptic, and many other things. This solectric energy penetrates the whole solar system, and there is a constant adjustment of this force according to the configuration of the planets and moon. The sum is constant, the whole passing continually from and to the sun; only local disturbances have to be considered. At intervals the earth becomes charged with solectric energy, both directly from the sun and indirectly from the planets and moon. According to the length of time that the earth is submitted to this force, so its manifestation will vary. If the accumulated energy is spread over a large flat country or an ocean, a storm occurs; if the energy has been gathering for ten or twelve days, and is concentrated in a mountainous district, an earthquake takes place; if the earth has been surcharged for a month or more, volcanic eruptions follow. But whatever the form of the disturbance, it is necessary that the sun or moon should be $57\frac{1}{2}°$ or 88° from the position affected at the critical moment.

If we have correctly interpreted the author, this expression means that the place must lie on a circle $57\frac{1}{2}°$ or 88° from the position in which the sun or moon is vertical. We have not been able to follow the process by which the position on either of these circles is definitely located, but evidently the operation is not a simple one, for the author intimates that a body of expert calculators will be required in order to apply the theory. But if the instructions are pursued rigorously, it will be possible to issue warnings to any state threatened by an earthquake, or to ships likely to be overtaken by a tempest.

Differing from many theories, the aim here is eminently practical, but if the author entertains any hope that it will be tested, we are afraid he is doomed to disappointment. Though we cannot agree with his conclusions, we should wish to treat Capt. Cooper

with great respect. He has witnessed many storms and startling phenomena in all parts of the world, and has sought to ascertain the causes according to his lights. Not being sufficiently acquainted with phenomena outside his own experience, and perhaps misled by the "long arm of coincidence," he has gone wrong, but the spirit of inquiry exhibited is very creditable, and much to be preferred to the display of indifference so often manifested by seamen and others.

Die Cnidosporidien (Myxosporidien, Actinomyxidien, Microsporidien). Eine monographische Studie. By Dr. M. Auerbach. Pp. viii+261. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1910.) Price 18 marks.

This memoir deals with an important group of parasitic Protozoa, associated with disease in cold-blooded vertebrates, especially fishes, and in invertebrates, for instance, pébrine in silkworms. The spores of these Sporozoa are enclosed in a valvate shell (the valves of which are shown to arise from two or three special cells in the sporoblast), which contains, besides one or more masses of spore-plasm, one to four polar capsules, each with a spirally-wound filament. The assertions of some workers that the polar filaments can be extruded and subsequently retracted are not borne out by the author's experience. The morphology of the vegetative forms and spores and the multiplicative and propagative reproduction are fully described; some form of sexual reproduction is now known to occur in members of each of the three subdivisions of the Cnidosporidia.

In the biological portion of the work the occurrence of the parasites is discussed, and an excellent host-index is given showing the Cnidosporidia recorded from each, with references to the records; the situation of the parasite and its pathological effects are described. In the systematic section an account is given of the genera and species described subsequent to 1897, which thus serves as a supplement to Labbé's account in "Das Tierreich" (1899). There are useful hints on technique, a list of 530 memoirs dealing with this group of parasites up to August, 1909, and an appendix giving a summary of the literature issued between that date and the time of printing. A comprehensive index completes this admirably arranged and useful monograph, which is illustrated with eighty-three half-tone figures.

Lehrbuch der Botanik für höhere Lehranstalten und die Hand des Lehrers, sowie für alle Freunde der Natur. By Prof. O. Schmeil. (Sechsundzwanzigste Auflage.) Pp. xvi+534. (Leipzig: Quelle and Meyer, 1910.) Price 5.40 marks.

The author of a book that passes through twenty-five editions in seven years has reason to be satisfied. Such is the record of Dr. Schmeil's "Text-book of Botany," which is intended for use in high schools and similar institutions, as well as for teachers and home students. It is largely a systematic compilation treating of phanerogams, with a shorter review of cryptogamic types; to this is added an account of general morphology and physiology, and a brief appendix on plant systems and geographical distribution. The success of the book may be attributed to the training value of systematic botany in a general course of education. The information proceeds by families, for which one or more of the important members is taken for tolerably full description, especially with regard to features of biological interest, while others, particularly those of economic interest, are mentioned, and in many cases figured. Among the numerous illustrations those portraying general habit and appearance are a notable feature. Most of the coloured plates refer to an individual species, but one is a representation of a wood in the carboniferous epoch. It would be useful if general characters were given for each family mentioned; as it is, they are omitted in those cases where they are not readily obtainable.

Four-Figure Logarithms on a New Graphic System, dispensing with Interpolations. By Dr. R. C. Farmer and M. M. Farmer. Pp. 8. (London: Longmans and Co., 1910.) Price 6d. net.

The authors of these tables have attempted to avoid the necessity of employing difference columns. With this end in view, numbers are printed on one side of a graduated line, drawn down the page, and the corresponding logarithms are placed opposite to them. The difference between successive printed numbers is 10 and the intermediate spaces are divided into ten parts. The logarithms are also printed at intervals of ten, and the correct subdivisions are indicated. It is claimed that more accurate readings will be made in this way than from the ordinary tables where a slight error in the fourth place occasionally occurs. But we must confess that we have found this new method a considerable strain on the eyesight, and there is the additional inconvenience of having three pages to consult instead of one. For practical purposes, ordinary tables give a sufficient degree of accuracy; we therefore doubt whether this new graphic system, in itself distinctly ingenious, will receive much support.

Die Abstammungslehre. By Dr. P. G. Buekers. Pp. xi+354. (Leipzig: Quelle and Meyer, 1909.) Price 4.40 marks.

This is a very good little book. It presents the main facts bearing on the theory of descent, which have been ascertained of recent years, within a convenient compass. The account of variability is very useful, but what will probably be found of greatest use to German readers will be the author's epitome of the mutation theory and his account of elementary species in Draba and Viola, of which there are some very useful figures. His chapter on the natural system of classification is very interestingly written; he deals at length and is evidently very much interested in the question of the minute discrimination rendered possible by a long training of the observation, and he mentions a bulb dealer who knows more than a thousand varieties of hyacinths from the dry bulbs alone. His concluding chapter embodies an attempt to hold the scales between the mutation theory and the theory of the selection of continuous variations. The author makes an unequivocal declaration in favour of the theory of mutation; his thoughtful analysis of the evidence on this question should ensure the book a wide circulation. It is to be hoped that it may be translated into English.

The Cornish Riviera. Described by Sidney Heath. Pp. 64. *The Peak District.* Described by R. M. Gilchrist. Pp. 64. *Dickens Land.* Described by J. A. Nicklin. Pp. 64. All pictured by Ernest Haslehust. (London: Blackie and Son, Ltd., 1911.) Price 2s. net.

These additions to the "Beautiful England" series which Messrs. Blackie are publishing contain all the attractive features to which attention has been directed in noticing previous volumes. Mr. Haslehust's beautiful pictures in colour, supplemented as they are by bright, entertaining letterpress, should assure the popularity of the volumes.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A House divided against itself.

MOST of your readers have doubtless heard of a question relating to the site of the Natural History Museum at South Kensington, and to a site for a new Science Museum. For the latter it is proposed to utilise the waste land behind the Natural History Museum, together with a portion of the site assigned to the Natural History Museum. The supporters of this scheme state that there is plenty of land for both museums, and have presented a memorial to the Government to this effect. Biologists learnt of this memorial largely owing to a Question and Answer in the House of Commons. They considered that such a proposal seriously imperils the future of the Natural History Museum. A second equally influentially signed memorial expressing these views is sent to the Prime Minister.

The spectacle is an edifying one. The scientific men of the country are roughly divided into two camps opposed to one another, while, as Sir Norman Lockyer says in a letter to *The Times*, May 30, "there should be no contention between these persons—their aims are the same; they desire to afford the best facilities for the increase and coordination of knowledge in all its branches." Is there no machinery which can make such contention only possible as a last resort? The records of the Royal Society and the British Association afford a hundred instances of the cooperation of all sections of scientific men, while the search for instances of the pitting of the different sciences against one another is almost vain. In questions which affect several sciences, surely it is possible for representatives to come together privately and discuss them freely. Probably in 90 per cent. of the cases an agreement would be reached, and both sides would cooperate for the good of science as a whole. For the due progress of human knowledge the cooperation of the different sections of science is more needed to-day than it has ever been in the past. All branches are becoming more and more woven together, and public contention between sections can only weaken the influence of science as a whole.

J. STANLEY GARDINER.

Cambridge, May 31.

Fishes and Medusæ of the Intermediate Depths. A note on the work of the *Michael Sars*.

DR. HJORT's account of the work of the *Michael Sars* during last summer's cruise [1] is of the very greatest importance to the marine geographer: it is the most illuminating article of its kind which has appeared within recent years.

Among the many interesting questions which are raised, I wish to direct attention here to one only, which is of particular interest to me because of my studies on the Medusæ of the intermediate waters, or the mesoplankton, if that term be preferred. This is the observations on the vertical range of the "black fishes," "shining silvery fishes," and "red prawns" of the intermediate depths.

Briefly stated, the result of Dr. Hjort's observations is that the adult black fishes and red prawns form an important community, the upper limit of which everywhere corresponds with the same intensity of light, *i.e.* practically with the lower limit to which sunlight penetrates with strength demonstrable by the photographic plate. This limit is deeper in low latitudes, nearer the surface in high, that is, about 500 metres between Newfoundland and Ireland; 700–800 metres at 33° N.; and when black fishes were taken from lesser depths, such captures were made at night.

The silvery fishes dwell at a higher level, where the light of the violet end of the spectrum penetrates with considerable strength.

These generalisations rest on such a mass of observation, and the methods of investigation were so well chosen, that they seem to me altogether deserving of acceptance; indeed, they form one of the most important of recent additions to our knowledge of oceanic biology.

Now, among the "intermediate" or "mesoplanktonic" Medusæ there are two similar colour groups, one unpigmented, or faintly pigmented, but often highly iridescent, as, for example, *Colobonema sericeum*, *Rhopalonema funerarium*, *Halicreas papillosum*; the second, characterised by very dense entodermic pigmentation, of a deep red, reddish-brown, or chocolate colour. Conspicuous genera among the latter are Atolla, Periphylla, Crossota, and Æginura.

Dr. Hjort's paper raises the question, Do the intermediate Medusæ, like the intermediate fishes, fall into two classes in their vertical distribution as well as in colour, and, if so, do the depth limits of the two correspond with those of the fishes and crustaceans?

Unfortunately, our knowledge of the bathymetric range of all the Medusæ in question is still extremely scanty. We know that they do not normally come to the surface except in very high latitudes, as, for example, Periphylla from the surface off Cape Adare in December, 1899, and January, 1900, the ice then being broken up, and in McMurdo Sound. On the other hand, the evidence which I have collated [1] shows that they are by no means exclusively abyssal. During the *Albatross* Eastern Pacific Expedition they were taken abundantly between 300 fathoms and the surface, and I have recently received an extensive collection from the north-western Pacific from the same depth zone.

Closing-net records are too few in number to be conclusive, but it is at least suggestive that in the eastern Pacific the *Albatross* took three genera of red Medusæ in a Tanner-net haul at 400 fathoms, one of which was also taken in the open net from 300 fathoms, but none of the transparent group, while at the same station two genera of the iridescent-transparent group were taken in a Tanner-net haul at 300 fathoms, and three specimens of a third transparent form, *Halicreas papillosum*, and one of a fourth, *Homoeonema alba*, were taken in the open-net haul from 300 fathoms to the surface.

These records certainly suggest that at this locality the red forms occurred, as a whole, below the transparent-iridescent ones, but that the two groups overlapped at, say, 250–300 fathoms.

In my discussion of the bathymetric range of the eastern Pacific Medusæ, I concluded that the upper limit of the intermediate forms probably corresponded, roughly at least, with the depth to which sunlight penetrates with appreciable strength. But the facts with regard to fishes brought out by Dr. Hjort suggests that my generalisation may not hold for the intermediate Medusæ as a whole, but only for the "red" genera.

This question can be settled only by further records; such, we hope, will be afforded by the *Michael Sars* Medusæ when they are worked up. But I direct attention to it here because, if it proves that red prawns, red or brown Medusæ, and black fish form a rather definite faunal group dwelling below the limits of light, as now seems likely, to which, too, the pelagic holothurian Pelagothuria probably belongs, the similarly excessive development of pigment in such divergent groups, in an environment of practical darkness, is a phenomena of great interest.

Such cases as this only emphasise the gaps in our knowledge of the life of the deep seas, and how rich a harvest of discovery still awaits the student who will explore the intermediate waters with a well-matured plan of operations.

HENRY B. BIGELOW.

Museum of Comparative Zoology, Cambridge, Mass.

Musical Sand.

WORKING with sand obtained from the beach at Barmouth, North Wales, I have been able to confirm most of the conclusions arrived at by Mr. Carus Wilson (NATURE, vol. xliv., p. 322) and by Mr. Skinner (NATURE, vol.

[1] *The Geographical Journal*, vol. xxxviii., pp. 349–377, 500–523, and NATURE, January 19, 1911.

[1] Reports on the scientific results of the expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U.S.F.C. steamer *Albatross*, ... XVI. The Medusæ, by Henry B. Bigelow. Memoirs Museum Comp. Zoology, vol. xxxvii.

lxxvii., p. 188), while the following additional observations have been made.

Distribution.—I found musical sand at intervals along the shore for more than ten miles north of Barmouth, at Whitesands Bay, Pembrokeshire, and at the North and South Sands, Tenby. This suggests that it is much more widely distributed along the shores of the British Isles than has hitherto been supposed.

Conditions affecting Pitch of Note.—I obtained the note by plunging a flattish pestle into an evaporating basin containing some of the sand, and there appears to be a definite relation between the curvature of the vessel and the pitch of the note produced. The following typical numbers were obtained with vessels of different material, which were approximately hemispherical in shape, the same pestle being used in each case:—

Vessels	A	B	C	D	E
Radius of curvature in cm....	5·4	5·1	4·7	4·4	4·2
Frequency of note (about) ...	1280	1440	1700	2180	2300
Inverse ratios of squares of radii	1·12	1·32	1·18	1·25	1·06
Ratios of frequencies	1·13	1·33	1·18	1·35	1·10
Vessels	A & B	A & C	B & C	C & E	D & E

When round-bottomed glass flasks are plunged into a milk-bowl containing sand, the pitch appears to depend on the curvature of the flask; *e.g.* flask

$$R = 3·5 \text{ cm gives note } n = 2050$$
$$R' = 4·2 \text{ cm gives note } n' = 1370$$
$$\frac{R'^2}{R^2} = 1·44 \qquad \frac{n}{n'} = 1·49$$

Within certain limits, a change in the temperature, the quantity of sand moved, or the gas present between the sand particles, appears to have no appreciable effect upon the pitch.

E. R. THOMAS.

University College of Wales, Aberystwyth.

The Protective Value of the Sticky Hairs on Young Leaves and Shoots.

IT is often difficult to imagine, and still more so to discover, the particular foes against which the hairs of young plants are a defence. In the course of the last two days I have noticed two instances in which the same foes have been successfully vanquished by a similar device on two widely different plants. The first instance was afforded by plants of *Salvia patens*, which had been removed from a cool frame to the shelter of a wall prior to being planted out in the borders; the second by the young leaves and shoots of several species of Rhododendron growing in my garden. The hairs of both these plants were abundantly laden with dead and dying hymenopterous gall-flies of several different species (? of the genus Andricus). I examined several individuals, and found them invariably to be females. They were caught by the legs, wings, or indeed almost any portion of the body. I failed to discover any insects other than the gall-flies captured by these hairs; and yet there were a few dipterous flies walking unconcernedly over the leaves, and in no way inconvenienced by the sticky hairs. The evidence would seem to point to these hairs being a special protection against gall-causing insects at a stage when the tender leaves and shoots would otherwise be very vulnerable by these tiny creatures.

OSWALD H. LATTER.

Charterhouse, Godalming, May 21.

The Teaching of Science in Secondary Schools.

THE report of the Board of Education on the above subject (see NATURE, May 4) contains many expressions of opinion with which I heartily agree. But I must beg respectfully to differ from the authors as regards the limitations they propose to put upon the use of everyday phenomena in science teaching. The report says:—"They should, of course, be introduced as *illustrations*, that is to say, when, and only when, they may happen to be wanted to give point to the teaching." This dogmatic statement ignores the fact that many well-known teachers strongly prefer the opposite mode of procedure. Upon their view a practical problem should be made the *starting point*, so that the development of the scientific method should follow instead of precede; *e.g.* from a study of the crane the class should discover the triangle of forces. The main argument for this procedure is that the boys actually want to know how a crane works, whereas interest in abstract principles does not, as a rule, outcrop until the age of sixteen or seventeen years. My own experience is distinctly in favour of the appeal to the utilitarian rather than to the scientific motive, except in the case of exceptional boys or of those above the age of seventeen.

G. F. DANIELL.

Oakleigh Park, N.

June Meteors.

THOUGH the long days and twilight nights prevent much attention being given to observations of shooting stars in June, still, important meteoric events are liable to occur in this month. The following are computed details of the four most important meteor showers that take place during the period June 9–30 in the present year:—

Epoch June 8, 17h. (G.M.T.), twenty-sixth order of magnitude. Principal maximum June 9, 9h.; secondary maximum June 9, 19h. 40m.

Epoch June 9, 6h., twenty-second order of magnitude. Principal maximum June 10, 9h. 35m.; secondary maximum June 10, 19h. 40m.

Epoch June 13, 12h. 20m., seventh order of magnitude. Principal maxima June 12, 5h., and June 12, 12h. 15m.; secondary maxima June 10, 23h. 10m., and June 12, 18h. 35m.

Epoch June 14, 4h., eighth order of magnitude. Principal maxima June 12, 23h. 20m., and June 13, 0h. 5m.

June 5. JOHN R. HENRY.

Daylight and Darkness.

I AGREE with Mr. W. T. Lynn that the article in NATURE of May 11 (p. 349) leaves "little to be said with regard to the so-called Daylight Saving Bill"; but there is one remark in it to which exception may be taken. This is the statement (p. 350) that it is "easy" to alter one's watch when travelling into a zone where different time is kept, if by "easy" is meant "not inconvenient." All travellers must have found the inconvenience of the change of time, even when reduced to a minimum through the change being an exact hour. Some inconvenience is unavoidable in travelling, but it is, of course, absurd to cause this inconvenience unnecessarily as the "Daylight Saving Bill" proposes. The inconvenience is such that in a journey to India I found it best never to alter my watch at all, it being simplest to keep to Greenwich time, and mentally make the allowance for local time.

T. W. BACKHOUSE.

West Hendon House, Sunderland, June 1.

HEREDITY AND DESTITUTION.

DURING the past week a conference has been sitting to consider possible means for the prevention of destitution. A general inaugural meeting took place on May 30, at the Albert Hall, and sectional meetings were held on several days at Caxton Hall.

Mr. A. J. Balfour, who delivered the opening address at the general meeting, struck a note of which echoes were heard throughout the congress. He devoted much attention to the bearing of heredity on destitution, and to the influence of the present selective fall in the birth-rate on the average economic efficiency of the nation.

Although Mr. Balfour held that some supposed

deductions from the principle of natural selection among mankind were not supported by facts, those who believe that the importance of heredity and selection in racial qualities has been too much neglected cannot but be grateful to him for raising boldly a question which our statesmen and politicians are only too prone to ignore. Almost anything which directs public attention to the subject is to be welcome.

While according a generous recognition to the importance of racial studies, Mr. Balfour asked the selectionist to face the question why he could perceive no "segregation of efficiency in the past between those who are better off and those who are worse off." Mr. Balfour implied that, unless a satisfactory answer could be given, the theory of natural selection as applied to mankind should be regarded with hesitation if not with suspicion.

Not everyone will share Mr. Balfour's inability to perceive a higher level of ability among the upper half of the nation as compared with the lower. Distinct evidence of segregation of special types of ability might be adduced. But the question why the process has not gone farther, why the upper classes do not show preponderant ability more markedly than they do, is worthy of consideration.

The whole problem of selective action in mankind, and especially civilised mankind, is fraught with difficulty, and tentative considerations alone can at present be put forward. One could imagine a society in which ability possessed full selective value, and a cumulative segregation of mental qualities gave to the best part of the race at all events, a much higher average efficiency than we can now show. But that society would in some respects be unlike our own. It would be more ready to accord all advantages to ability without envy or hesitation; it would be much firmer in visiting weakness of mind or body with appropriate disabilities. It would secure in some way that able men and women should be encouraged to have a full complement of offspring, and should be placed in a position where a hunt for heiresses by themselves or their sons would not be necessary to support the position won by their own ability, for, as Galton pointed out, heiresses usually come of infertile stock, and too often extinguish the family which captures them.

These considerations may serve to give us the clue to Mr. Balfour's problem: Why are not our upper classes more markedly superior in ability to the lower?

First, ability, even ability which leads to achievement, does not necessarily secure a more able partner. A man rising rapidly too often either marries unwisely before he has risen, or, engaged in the struggle to advance, marries not at all, or too late, to leave many offspring. One or two children are not enough to give the hereditary ability a full chance of appearing. Thus the favourable variation is destroyed in the first generation.

Secondly, if he marries appropriately and rears a large family, that family has still many dangers to run. Unless the ability be of the type which wins great wealth, and unless the opportunity for winning that wealth occurs, a search for well-dowered partners will probably extinguish some lines of offspring. Or again, if wealth renders this search unnecessary, some of the children may fall a prey to the needy adventurer with undesirable mental qualities.

Thirdly, when a family becomes firmly established among the upper classes, the pressure of selection becomes less acute. Places are found for the sons, whether their abilities deserve them or not; some of the daughters make good marriages, regardless of whether they possess their share of the family ability. Selection ceases to a great extent, and reversion to a lower level inevitably occurs.

These reasons apply to all the ages during which modern society has been developing. But, during the last forty years, the voluntary and deliberate restriction of the birth-rate among the more successful stocks of the nation has introduced a new cause which affects chiefly those among whom its results are most disastrous from the point of view of the nation and the race.

An able man and an able wife—a pair nearly sure to produce a high proportion of able offspring—too often regard the interests and duties, which their ability thrusts on them from all sides, as a reason or an excuse for restricting severely the number of their children, or for refusing the burden of parenthood altogether. For the last forty years the power of doing so has been changing slowly but surely the whole aspect of racial problems.

But, while we may give reasons to explain the comparative want of segregation of ability, it should be recognised that signs of partial segregation of ability are not totally wanting. At present, it is probable that selection is keenest and most effective in the professional class, and competent observers are to be found who believe that the average ability among the sons of professional men is higher than in any other class in the community.

During the eighteenth and early nineteenth centuries, there were frequent intermarriages between the leading political, administrative, and military families, and a statistical analysis of the entries in the "Dictionary of National Biography" gives us evidence of distinct accumulation of those special types of ability in the governing class during that period. The rarity of such accumulation in other cases may well be due largely to the want, in other sections of the nation, of distinct classes, corresponding to the different types of ability. If mates were naturally sought from within the limits of a definite class, access to which was more and more jealously guarded as its efficiency and ability increased, a similar and more marked segregation of ability might appear in other directions.

But Mr. Balfour saw another difficulty in the path of a selectionistic interpretation of social phenomena. As Dr. Archdall Reid has shown, disease is now one of the most effective selective agencies at work among mankind. By the early elimination of those specially susceptible to a given disease, the race is gradually becoming more and more immune to that special scourge. If we diminish the infection of the disease by improved sanitation and knowledge of hygiene, this process of immunisation will cease, and the race will revert to a more susceptible state. Hence, Mr. Balfour argued, no convinced selectionist should advocate improvement in our sanitary environment.

Doubtless, improvement in the environment has its dangers. It may keep alive to reproductive age many of weak physical or mental constitution, who would, for the sake of the race, be better out of the way. We shall guard against those particular dangers all the better for facing them with open eyes. But immunity from certain special and preventable diseases is not the highest quality of the ideal man. If we can guard against infection in other ways, it may well be that greater aggregate advance will be made when we can prevent the waste now incurred by nature in protecting the race against that particular disease. As our knowledge of inheritance, Mendelian or other, is increased, we may be able to point the

way to combining immunity from the disease with other valuable qualities. Meanwhile, it is unwise to lose the chance of preserving those other qualities, which may now be linked with susceptibility to the disease, for want of the sanitary precautions which advancing knowledge puts in our power. Thus the selectionist escapes from Mr. Balfour's dilemma, and may support with a clear conscience all efforts towards improvement in the environment, provided that it is fully realised that improvements in the environment alone will not necessarily improve the innate qualities of the race, any more than better cow-stalls will of themselves improve without limit our breeds of cattle, and, provided that all efforts are also made deliberately to encourage reproduction among the best stocks, and to discourage it among the worst.

But consideration of these general problems, interesting though they are, is not necessarily essential to the application of the principles of heredity to the treatment of destitution—the immediate object of the conference opened by Mr. Balfour's speech. Whether or no there is a general segregation of ability broadly between the upper and the lower classes in this country, it is undeniable that the ranks of the paupers contain a certain proportion of those who, mentally or physically, are hereditarily unsound. It is the fact that the differential birth-rate is telling in favour of the unsound as against the sound that is so sinister, even more so than its effect on the relative rates of reproduction of different social classes.

No one denies that many fall into reach of the Poor Law through no fault of their own. By seasonal unemployment, by movements of trade, by the pressure of temporary illness or economic misfortune, relief becomes necessary. To meet these cases, every attempt should be made to improve the organisation of the labour market, to obtain more effective education, to prevent blind-alley occupations for boys and girls. Such subjects met with their full share of consideration at the conference, and will always appeal with greater force to the philanthropist, who wishes to relieve immediate distress, and to the politician who wishes to capture votes by doing so.

But, as all those who administer the Poor Law with their eyes open know, these cases are but part of the problem. A large number of the occupants of our workhouses and prisons are congenitally defective in mind or body. Often, for the feeble-minded or unsound themselves, there is no hope of improvement, and, even in cases where, at great expense to the community, they can be taught a trade in special schools, as Mr. Balfour pointed out, their acquired characters will not be inherited, and their offspring will tend to reproduce their infirmities. The feeble-minded are specially prolific, and, in this time of a general fall in the birth-rate, are increasing relatively to the other sections of the community. Several years ago, a Royal Commission reported in favour of the compulsory and permanent care and detention of the mentally defective. That nothing has been done to carry out the recommendations of the Commission, in spite of the urgency of the case, is a standing disgrace to the Government and to the Parliament of this country. Were these unfortunates shielded from the degradation which follows their so-called freedom, and prevented from handing on their defects to future generations, this part of the problem of destitution would be solved, and a heavy burden of incompetence and pauperism removed once for all from the shoulders of the competent, who, there is now reason to fear, often restrict the number of their offspring to meet the increasing load of taxation required to support the inefficient members of the community.

Several of the special papers read to the sections of the conference dealt with the problem of mental defect as a cause of pauperism. On May 30 Dr. F. W. Mott and Dr. A. F. Treadgold dealt with the insane and the feeble-minded in their hereditary aspects. Dr. Mott pointed out the significance of the fact that a considerable proportion of the inmates of the London County Asylums were related to other inmates, while Dr. Treadgold gave evidence that feebleness of mind was more prevalent in the rural districts. It should be noted that rural districts which have specially been depleted by immigration to the towns seem particularly affected in this way. The worst strains get left, and the inbreeding of defective stocks intensifies the evil. Dr. Treadgold said that the real cause of the existence of a certain class of parasitic pauper was germinal defect, and emphasised the folly of allowing such a class to propagate freely. On Wednesday Sir William Chance pointed out that, whatever the cost of segregation, it would be repaid in a generation many times over by the saving in workhouses and prisons. Other papers on mental defect in its bearing on pauperism and crime were read by Mr. T. Holmes, Dr. C. H. Melland, Miss Mary Dendy, and Dr. F. Needham, while Dr. C. W. Saleeby spoke on the eugenic summary and demand.

Whatever be the effect of the conference on legislation or administration, it is impossible to follow its proceedings without perceiving that the thinking world is at last waking up to the fact that biological knowledge has an intimate bearing on sociology. The last few years have seen a great change in this respect, and, though much more is yet to be done, the future is full of hope. W. C. D. W.

PLAGUE.

THE recent epidemic of plague in northern China with its 60,000 deaths, is remarkable in two respects. First it was the most extensive manifestation of pneumonic plague in this pandemic; and, secondly, it was characterised by a more or less sudden cessation. It affords a warning as to the capabilities of the disease. and as to one of its possible developments, and although the outbreak has come to an end for the time being without any great efforts in the direction of prevention, yet it has demonstrated that the plague of the present day is as powerful for mischief and as capricious in action as that of any period in the past centuries. Arising in or close to eastern Mongolia, where the ordinary annual epidemics of plague have for many years shown a tendency to a comparatively high percentage of the pneumonic type, this influenzal form, shorn of the bubonic variety which has hitherto accompanied it and has been its predominant partner, appears to have been conveyed as early as October, 1910, to some of the more recent settlements on the Manchurian portion of the Trans-Siberian Railway.

The increasing mortality in these settlements did not attract any particular attention until December. when, in consequence of panic following an appreciation of the situation, there ensued a great exodus of the Chinese, both by rail and by road, to their homes in the more southern provinces of Shinking, Chili, and Shantung. To the infection thus carried far and wide the rapid and extensive dissemination of the disease and the formation of new centres may be traced. But the virulence and great mortality which characterised the epidemic in some places and its comparative harmlessness in others are not so readily explained. The cause or causes of these variations have always been, and still remain, a per-

plexing problem, and our knowledge regarding the vehicles of infection and the part played by animals, insects, and man in the spread of plague do not at present assist us in its solution.

From the information available it would seem that the early infected centres suffered severely, while those that were infected later suffered but little. Possibly their immunity was because they were infected later in the season, for the disease towards the end of February and beginning of March began everywhere to lose its strength and power of diffusion which could not be attributed to preventive measures. This is no new phenomenon with pneumonic plague, and it is one which is well worthy of close investigation. This occasional self-limitation of pneumonic plague independent of active measures in no sense justifies the conclusion that preventive measures are unnecessary and useless in this form of plague. On the contrary, measures taken earlier would have further curtailed the outbreak. Prompt and early action is important and urgent, because no one can tell when a pneumonic plague is self-limiting and may confine itself to a few villages, or when it may have the force of a pandemic and spread if unchecked from country to country.

While much attention has been directed to the mortality in Manchuria from the pneumonic variety of plague, the ravages of the bubonic form in India have not been noticed, and yet the mortality of the latter far exceeds that of the former. Since 1896, when the disease was imported into Bombay, there have occurred in India seven million deaths from plague. The mortality varies in different years. Some years it is greater and in others less, but never since the disease appeared in the country has any year been free of mortality. Two provinces have been affected more than the others. One is the Punjab, with a population of only twenty millions, the other the United Provinces of Agra and Oudh, with a population of forty-seven millions.

The plague deaths in these two provinces during the past twelve years have been as follows (statistical abstract relating to British India from 1899 to 1909):—

	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910
Punjab	255	572	14,959	171,302	205,462	396,357	334,891	91,712	608,685	30,708	35,655	152,387
United provinces of Agra and Oudh ...	7	135	9,778	40,223	84,499	179,082	383,802	69,660	328,862	22,878	39,394	139,328

In the Punjab the plague mortality increased from 255 in the year 1899 to 396,357 in 1904; then it declined for two years. In 1907 it rose to the enormous number of 608,685, and in 1908 and 1909 fell to a comparatively low figure. In the United Provinces of Agra and Oudh the mortality increased from 7 in the year 1899 to 383,802 in 1905; there was then a decline for one year, a rise to 328,862 in 1907, and a further decline in 1908 and 1909. Both in the Punjab and the United Provinces the deaths in 1910 have again risen, and the upward tendency is being continued in 1911, particularly in the United Provinces, as is shown by the following statement of the plague mortality in January, February, and to the week ending March 25th:—

Months	United Provinces	India
January	35,000	65,000
February	41,000	85,000
March	72,000	131,000
Total ...	148,000	281,000

In the first three months of 1911 the deaths from plague in India were 281,000, and in the United Provinces 148,000, which are respectively nearly five times and more than twice the mortality from the disease in China from October to March inclusive.

With this mortality in China and India it is difficult to realise that only twenty years ago plague was considered to be practically an extinct disease. True, it lingered in some of its old homes, but to such a small extent that it was hoped that even in these it would finally disappear. Now the whole position has changed. The slow but wide dissemination of the disease since it first attacked Canton in 1893 and Hong Kong the following year, and which has been followed by the infection of many countries in different parts of the world is one of the most remarkable and sinister events of the age. Its importance hitherto has not been connected with its mortality, for with the exception of China and India the deaths from the disease have been few, but it lies in the fact that every year the sowing of infection among susceptible and subterranean animals becomes more extensive, and that countries which have for hundreds of years been free of plague infection are no longer in that position.

The danger lies in the disease among animals being permitted to acquire a firm foothold wherever it may be, for the infection in such circumstances is difficult to eradicate. The insidious manner in which the infection gets imported into a country, the ease with which human cases have been hitherto dealt with, and the apparent difficulty the disease has in spreading, or even maintaining its hold, are apt to lull the suspicions of even the most wary. Thus with no immediate results forthcoming it is not surprising for it to be assumed that the twentieth-century civilisation has, so far as the West is concerned, deprived plague of its powers. It was to advancing civilisation the disappearance of plague from Europe was attributed, regardless of the fact that a similar disappearance had taken place in the East, and that recessions and long periods of rest from plague are matters of history. Plague, when it broke out in Bombay, had not been there for 184 years. Until then Bombay had prided itself on its sanitation, with its immense waterworks and drainage; and its external appearance was that of a fine and thriving city. But plague was the most informing sanitary inspector it ever had, and revealed the actual housing condition of the people, and it is just as likely, in due time and under favourable conditions, to visit the crowded and verminous slums of the cities of the West, where the "awakening of the insects" in the houses is as regular in season as that in China.

The disease is one which essentially affects the very poor, whose condition still make the cities of Europe vulnerable. It has always been called the poor man's plague. The one great advantage the West possesses over the East, which it did not possess in former times, is the power of trained organisation. It is on intelligent organisation based on scientific knowledge rather than on any great advance in the housing of the very poor in Europe that reliance will have to be placed to combat the disease and to secure safety from any great epidemic. In the meantime, in addition to systematic and continuous measures against infected animals in places where the disease has been imported, special attention requires to be directed everywhere against verminous houses and verminous people.

W. J. Simpson.

ON THE BLUE AND WHITE NILES.[1]

THE reorganisation of the regions of the Upper Nile after the destruction of the Dervish power and the steady growth of prosperity in every district has profoundly impressed all who have travelled in the Sudan. The history of these last twelve years' work has yet to be written, for the account of Mahdi-ism, by Sir Reginald Wingate, the present Governor-General, only dealt with the events which led up to the re-conquest of the country to the south of Wadi Halfa. Yacoub Pasha Artin, for many years Under-Secretary of State of the Ministry of Public Instruction in Egypt, does not attempt to provide such a survey, for which perhaps the time has not yet arrived, but has given us instead a series of delightful sketches of these lands, which are being more and more visited each year. Written in form of letters setting forth his daily experiences, his conversations with those he met, Europeans, Egyptians, or Sudanese, first impressions noted on the spot when all was fresh and vivid, this account of the regions of the Blue and White Niles is not only of interest but has a special value on account of the author's intimate knowledge of Oriental life and history.

FIG. 1.—A "Sadd" on the River. From "England in the Sudan."

Starting early in November, Artin Pasha, accompanied by Prof. Sayce, was able to take advantage of the favourable flood of 1908 and reach Roseires, on the Blue Nile, by steamer; thence, returning to Khartoum, he traversed the White Nile as far as Gondokoro, on the northern frontier of Uganda, thus visiting the two main lines of communication and many of the stations on their banks. All attempt at a scientific account of the country is disclaimed, but indications appear frequently that the systematic study of the country and its resources is everywhere being carried on so far as means are available. Mention of the Department of Woods and Forests bears witness to this, for the demand made upon the trees on the banks of both Blue and White Niles for the steamer traffic can only be prudently met by careful conservation of the present supply. Inspectors have been appointed, and though difficulty was experienced at first in obtaining local labour, this has been overcome, and now funds alone put a limit to the conservation possible. Both here and on the White Nile forest fires constitute the greatest danger to the young growth, but even these are being to some extent controlled.

The efficiency of the present administration is dwelt upon, though mention is made of cases where the Oriental foot finds the Western shoe to pinch inconveniently. In the area occupied by Arab tribes the question of slavery outweighs all others. An Arab sheikh discussed it frankly with the author, laying down that Arab landowners were incapable by habit and custom of working their land themselves, that they have always had negro slaves as cultivators, and that losing the slaves ruin will stare them in the face. Such changes can but be made slowly, but with the present increasing prosperity of the country and the suppression of inter-tribal warfare, even the Arab tribes will shortly accommodate themselves to new conditions. The author is especially qualified to present the local opinion, but he rarely states his own view of the merits of the questions raised.

On the White Nile a short stay was made at Kodok (formerly Fashoda), where the pastoral tribe of Shilluks has its headquarters, and descriptions of these interesting people are given. Under their own chief, the Mek, they have readily fallen in with the new *régime*, by which their tribal customs are respected, but retain the deepest hatred of those whom they call Turks, the slave merchants and slave-hunters of former days. Between this point and Gondokoro the Nile flows through a narrow valley plain, mainly occupied by marshes and lagoons, which provide the drift marsh vegetation, which at times is carried by wind and current into narrow channels or acute bends of the river, there to form a dense obstruction, the "sadd" proper. Loose application of this term to the region generally, to marsh vegetation, and to drifting vegetable matter, is to be deprecated, and even in the present account it is employed with some latitude. These obstructions have often been described, and Marno gave a very full account of them in 1880 and 1881. Though more understood to-day, the conditions which determine their formation are not controlable, so that during the late summer and autumn months, when rain and stormy weather prevail, constant care has to be exercised by the steamers passing up and down to remove any block that may be forming before it grows too solid. Among the illustra-

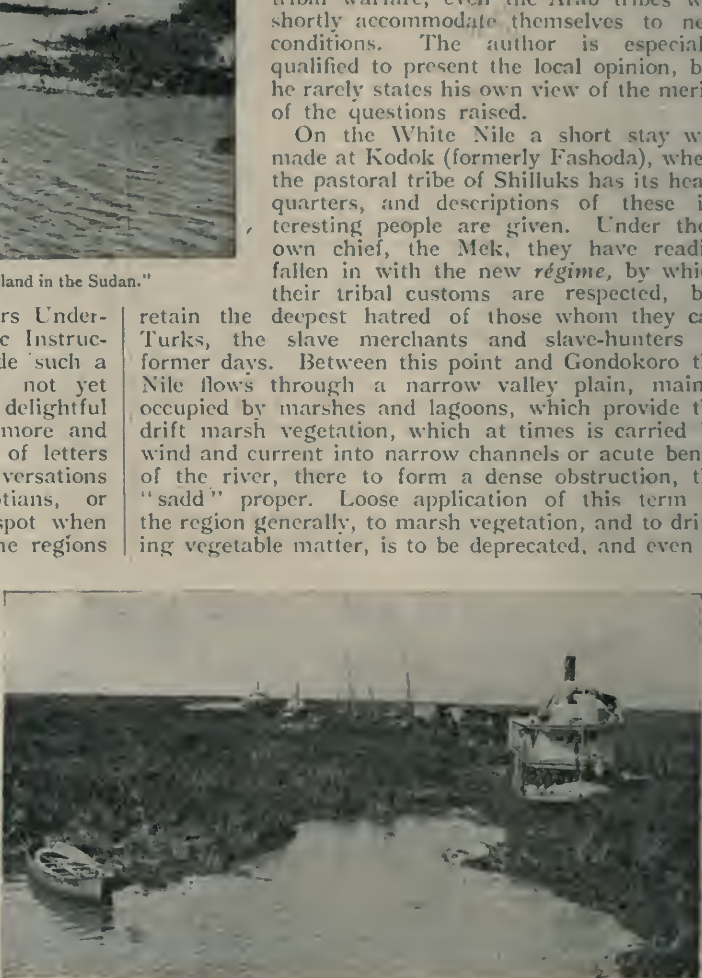


FIG. 2.—Stuck in the "Sadd." From "England in the Sudan."

[1] "England in the Sudan" By Yacoub Pasha Artin. Translated from the French of the author by G. Robb. Pp. xvi+251+map. (London: Macmillan and Co., Ltd., 1911.) Price 10s. net.

tions are two which are here reproduced by permission of the publishers. One shows a "sadd" sufficiently solid to check the flow of the river and form a lagoon; in the other both steamers and sailing boats have been brought up by a more compacted barrier of the same kind.

Khartoum is fully described, and the scientific work carried on at the Wellcome Laboratories is referred to. So many points of scientific interest are alluded to, having a bearing on various branches of knowledge, that we can only regret that the results have not a wider circulation and greater accessibility than is afforded by the annual official reports. The founder of the Wellcome Laboratory renders the results of its staff available, but in forestry, hydrography, and also in all that concerns the native races of the Sudan those who are working there are gaining data which have a value and importance beyond their own region. The illustrations greatly assist in forming an idea of the country described, but the map is not so satisfactory; it would be of more use if the modern place-names were correctly given and a consistent orthography employed.

H. G. L.

THE STRUCTURE OF HAUSALAND AND ITS NEIGHBOURHOOD.[1]

IF there is one point more than another which calls for the attention of the geologist in West Africa it is the position and age of the older sedimentary series, *i.e.* the beds between the presumably Archæan gneiss and the Cretaceous strata.

Such information as is available about these rocks, quartzites and argillites, grits and phyllites, is fragmentary, and obtained from a variety of sources throughout West Africa, often from localities where no recognised survey has taken place, and where the relations of the component rock groups are unknown.

On the western side of northern Nigeria we have such a sedimentary series frequently exposed, and with this Dr. Falconer, in his book, "The Geology and Geography of Northern Nigeria," has dealt at length. He regards these rocks as the scarcely altered representatives of a group of schists and sedimentary gneisses, termed the "softer" gneisses, because of their relatively low capacity for resisting erosion, and believes that they were deposited upon a surface of Archæan gneiss—the "hard" gneiss—and affected thereafter (*a*) by regional metamorphism, and (*b*) by folding.

It can scarcely be doubted that the quartz-schists and quartz-muscovite-schists of Kabba and Ilorin are the same as those of the Central Province of southern Nigeria, a correlation which can probably be extended to the rocks of the Eastern Province, and possibly—for the general character of these schists is exceedingly constant—to other parts of West Africa.

Dr. Falconer, who states his case with great fairness, has accordingly advanced an hypothesis of considerable importance, but it would have greatly aided the reader and enhanced the value of the work as a book of reference if some plates had been included showing the minute structure of the rocks.

The book is technical and solely for the geologist, and, though one would be loth to lose any of the excellent photographs with which the author has embellished his work, one ventures to think that in some instances microscopy might have taken precedence.

The granite intrusions (see Fig. 1) are pre-Cretaceous in age, and fall into two subdivisions: an older foliated, and a younger non-foliated group, which includes soda-granites. The pneumatolytic modification of some of these granites, as at Bukuru, has as a distinguishing feature cassiterite and sulphides of copper, zinc, and lead.

The Cretaceous beds, confined to parts of the valleys of the Benue and its tributary, the Gongola, fall into an upper and a lower series of grits and sandstones, divided by a limestone-shale series of Turonian age. It is interesting to note the presence of salt in the

FIG. 1.—Exfoliation in the Kilba Hills. From "The Geology and Geography of Northern Nigeria."

lower grit series, and of veins of galena and blende at Arofu, doubtless connected with a small inlier of granite near the town.

Salt occurs in the north-eastern part of southern Nigeria, as do also galena and blende, which facts, together with the probable existence of Turonian beds in the same neighbourhood, suggest a general similarity in history.

In both Protectorates the Cretaceous beds are pierced by dykes and sills of dolerite.

Dr. Falconer lays some stress on the unconformity which he believes to exist between the Cretaceous and Eocene beds; and is worthy of note, in view of Mr. Kitson's opinion that a passage exists in southern Nigeria between the Mesozoic and Cainozoic.

There are three groups of Eocene beds in northern Nigeria, of which the western only has yielded fossils; the others are correlated with them on petrographical grounds, and on their position as regards the known Cretaceous.

Of these beds the first, especially around Sokoto, where limestones and calcareous clays and shales occur with efflorescences of alum and gypsum, is the most interesting; the beds of other localities consist largely of ferruginous sandstones and grits, types only too prevalent in either of the two Nigerias.

[1] "The Geology and Geography of Northern Nigeria." By Dr. J. D. Falconer, with notes by the late A. Longbottom and an appendix on the Palæontology of the Cretaceous Deposits by H. Woods. Pp. xv+295+24 plates. (London: Macmillan and Co., Ltd., 1911.) Price 10s. net.

These sandstones are unfossiliferous, and an absolute proof of their Eocene age must accordingly be wanting; but, *faute de mieux*, Dr. Falconer makes out an excellent case and presents his facts clearly.

The book concludes with chapters on "The Superficial Accumulations," "Tertiary Crustal Movements," and "Tertiary Volcanic Action," each worthy of the close attention of the student of African geology. Two periods of Tertiary volcanic activity are recognised, respectively middle Eocene and late Pliocene; to the latter are referred some excellently preserved puys (Fig. 2) developed in the Province of Yola, the middle Benue valley and on the Bauchi plateau.

The rocks of the earlier outburst are an interesting series of phonolites and nepheline-basalts, of which the conspicuous stumps of the Tangale Peak and the Wase rock may be taken as typical examples.

In regard to the late earth movements, one conclusion of general interest may be recorded here, viz., that the culmination of the Tertiary oscillation resulted in the formation of the Bauchi plateau and the establishment of the present river system.

Fig. 2.—Craters in the Mboi Hills. From "The Geology and Geography of Northern Nigeria."

The Bauchi district is inseparably connected with the tin industry, and we could wish that Dr. Falconer had seen his way to more details, put in plain and concise phraseology, of the alluvium-containing cassiterite.

The sudden prominence into which the tin-mining industry has burst in northern Nigeria naturally leads the reader, in such a work as this, to expect authoritative information in a form to be readily assimilated.

Mr. Henry Woods has contributed an appendix on the palæontology, and the book as a whole is full of valuable information to the student; the geological map on a scale of 1 : 2,000,000 is indispensable to those interested in the structure of this part of Africa.

As Dr. Falconer himself readily admits, his work may require some modification in the future, but all who are acquainted with the difficulties of the African pioneer will give him full measure of praise for the results he has attained. In such circumstances to quibble over detail is an ill task, but the first chapter on the "Physical Geography" might be compressed and summarised with advantage to the general reader, and perhaps many will find a too great elaboration of detail throughout the work. John Parkinson.

DR. HARRY BOLUS.

The name of Dr. Harry Bolus is closely associated with the story of South African botany for the last forty years. In April, 1874, a letter to Sir Joseph Hooker was read at a meeting of the Linnean Society, of which Bolus had recently been elected a fellow (December 18, 1873), in which he criticised Grisebach's limitation of the Cape and Kalahari floral provinces (see Journ. Linn. Soc., xiv.). This was the beginning of a series of publications embodying the results of his observations on the flora of a peculiarly rich and attractive botanical area. In 1886 Bolus wrote for the official handbook of the Cape of Good Hope a valuable "Sketch of the Flora of South Africa," in which he proposed a series of natural botanical divisions, forming, roughly, successive zones from the coast northwards. From 1881 to 1889 he communicated to the Linnean Society a number of contributions to South African botany, containing critical notes on various genera and species, as well as descriptions of many novelties; but it was to the heaths and orchids that he was especially devoted. The results of his study of the large and intricate genus Erica are found in his monograph (in part of which he had the help of the late Prof. Guthrie) in the "Flora Capensis" (vol. iv., sect. 1, issued in 1905), where the 469 species are described in detail, and arranged under forty-one sections.

In his volumes on South African orchids, Dr. Bolus has established a model of detailed description and illustration; accompanying each species is a plate, drawn by Dr. Bolus himself, in which a judicious combination of outline and colour gives exactly what is wanted by the botanical student. Dr. Bolus had just completed this important work at the time of his death, which occurred on May 25, when on a visit to England. Mention should also be made of the excellent series of specimens illustrating the Cape flora, by the distribution of which to various great herbaria Dr. Bolus brought his collections within reach of a large number of students of systematic botany. An account of his services to botany would be incomplete without a reference to his generous support of the Cape University, which owes to him the foundation of its chair of botany; and Dr. Bolus himself would have wished some acknowledgment to be made of the help which he received in all his later work from his niece and pupil, Miss Louisa Kensit. A. B. R.

NOTES.

The Croonian lecture of the Royal Society will be delivered on June 15 by Prof. T. G. Brodie, F.R.S., on "A New Conception of the Glomerular Activity."

On Tuesday, June 13, Prof. Ernst Cohen, of the University of Utrecht, will give an illustrated lecture before the Faraday Society on "Allotropic Forms of Metals." Prof. T. W. Richards, of Harvard College, has been invited to take the chair on this occasion. Applications for tickets should be made to the secretary, 82 Victoria Street, London, S.W.

PROF. A. WILLEY, F.R.S., of McGill University, Montreal, has directed our attention to the inclusion in his article "Amphioxus" in the eleventh edition of the "Encyclopædia Britannica" of two cuts (Figs. 2 and 3) which, though described there as "original," and therefore inferentially as drawn by himself, are really reproduced from Sir E. Ray Lankester's article "Vertebrata" in the ninth edition. We understand that these illustrations of amphioxus were added to Dr. Willey's article without his knowledge by the editor of the zoological section of the eleventh edition, in accordance with his scheme for the reorganisation of the whole series of articles; but, by an oversight, the description "original" was not altered to "Lankester," as it should have been. We have received a letter from the editor-in-chief regretting the error, which will now be corrected, and making it clear that Dr. Willey himself is not responsible for what might appear to ignore the original work of another distinguished zoologist.

THE fine collection of African birds formed by the late Mr. Boyd Alexander, and bequeathed by him to the Natural History Museum, has now been handed over to that institution by his executor, Mr. Robert Alexander. The collection includes the birds obtained by Mr. Alexander during his expeditions to the Cape Verde Islands, the Zambezi and Kafue Rivers, the Gold Coast Hinterland, and the Island of Fernando Po, as well as those secured during the Alexander-Gosling expedition in 1904–7 from the Niger to the Nile. The collection includes, also, all the specimens obtained during his last journey to the islands of San Thomé, Principe, and Annobon, in the Gulf of Guinea; on the Peak of Cameroon and mountains to the north; and in Wadai up to the time of Mr. Alexander's death. This bequest to the Natural History Museum is of great value, for it supplies beautifully prepared skins and complete series of the avifauna of islands and countries hitherto very imperfectly represented in the national collection of birds. The present collection comprises nearly 4000 bird-skins, and includes the type-specimens of no fewer than eighty species described for the first time by the late Mr. Alexander in his papers published in *The Ibis* and elsewhere.

WITH the object of promoting and systematising chemical work of general importance to all engaged in the development of that science by research or by teaching, an International Association of Chemical Societies has been formed as the result of a conference of delegates from the chemical societies of England, France, and Germany, held in Paris on April 25 and 26. The three leading societies of the countries named had been invited by the president of the Chemical Society of France to cooperate in this movement and to nominate delegates to represent their respective societies at the inaugural meeting. The representatives of the Chemical Society of London were Prof. P. F. Frankland (president), Prof. Meldola, and Sir Wm. Ramsay. The Chemical Society of France was represented by Profs. Béhal, Haller, and Hanriot, and the German Chemical Society by Profs. Jacobson, Ostwald, and Wichelhaus. With the exception of Prof. Meldola, who was unable to attend, all the delegates were present at the opening meeting, when the association was formally founded and the statutes framed and adopted. From these statutes we learn that the objects of the association are to be promoted by the appointment of committees charged with the consideration and investigation of questions submitted by the council, by the publication of the results of such investigations, and by the holding of conferences and congresses. It was decided at the opening meeting that the first international committees should be appointed for dealing with the questions of nomenclature in mineral and organic chemistry, and with the unification of the modes of stating physical constants. The next meeting of the association is to be held in Berlin on April 13, 1912, with Prof. Ostwald as president, and the 1913 meeting is to be held in Great Britain.

THE death is announced, at seventy-two years of age, of Dr. A. E. Törnebohm, the Swedish geologist.

THE twenty-second annual conference of the Museums Association will be held at Brighton on July 10–15 under the presidency of Mr. H. M. Platnauer.

THE President of the Board of Education has appointed Mr. H. H. Thomas to succeed Dr. J. S. Flett as petrographer to the Geological Survey of Great Britain.

PROF. JOHANNES HARTMANN, professor of astronomy at Göttingen and director of the University observatory there, has been appointed, says *Science*, director of the Argentine Observatory at La Plata.

MR. A. J. WILMOTT, late scholar and Hutchinson student of St. John's College, Cambridge, has been appointed an assistant in the department of botany of the British Museum (Natural History). Mr. Wilmott will devote himself especially to the European and British collections.

DR. IRVING has found the remains of another horse at Bishop's Stortford. As the bones were lying under some 6 feet of peat along with those of a small ox of the *Bos longifrons* type, it may be provisionally assumed they belong to the Neolithic age.

AT the recent annual meeting of the Paris Society of Friends of Science, Prof. M. L. Joubin, the general secretary of the society, announced that during the preceding year 80,000 francs had been distributed to men of science and their families who were in need.

THERE will be a meeting of the Biochemical Club at the Rothamsted Experimental Station, Harpenden, Herts, on Saturday next, June 10. The director and staff of the station have kindly consented to conduct members round the various plots in the morning and in the afternoon. The honorary secretary of the club is Mr. R. H. Aders Plimmer, University College, Gower Street, W.C.

THE death is reported of Mr. Samuel Hubbard Scudder, the veteran American naturalist, in his seventy-fourth year. Nearly fifty years ago he was a museum assistant to Louis Agassiz. He subsequently held various posts in connection with the Boston Society of Natural History, the Harvard University Library, and the U.S. Geological Survey. He had a wide reputation as an entomologist, particularly on account of his numerous volumes on butterflies.

IN a recent letter to *The Times*, Prof. Marcus Hartog directs attention to the fact that there is no provision made in the new Copyright Bill in reference to reproduction on lantern-slides for teaching by recognised teachers. He points out that an actual researcher is usually gratified at the implied recognition of his work when it is utilised by others, and that permission to copy the figures in original papers is not, as a rule, asked for, save, perhaps, as a matter of form. But with reference to standard text-books there seems to be much doubt. Prof. Hartog asks, "Would it not be possible to insert a clause specifying that unless the right were expressly reserved, no prosecu-

tion would lie for the making, obtaining, and using of lantern-slides taken from a publication by or for a recognised teacher for class demonstration or the illustration of a paper before a learned society?"

An appeal against the use of the New Forest for military manœuvres, signed by a large number of distinguished zoologists, botanists, ornithologists, entomologists, and other naturalists, appeared in *The Times* of June 2. The appeal, after referring to the use of the New Forest in this way in May, points out that May and June are exactly those months of the whole year in which non-disturbance is of vital importance to the birds, insects, and plants which give to the New Forest its unique interest, not only for men of science, but for all educated persons who take an interest in natural history. The damage done by bodies of troops during this period must inevitably result in a destruction of the wild life of this area that can never again be repaired. The signatories recognise that manœuvres must be held, but express the wish that wild tracts of country other than the New Forest might be utilised for the purpose; and, if this cannot be, that future manœuvres may at any rate be deferred until after July 15, when less harm would be done.

A spell of exceptionally bright and warm weather was experienced over the British Isles at the close of May and at the beginning of the present month, and some exceptionally high temperatures for the time of year have occurred. For thirteen consecutive days, from May 25 to June 6, the shade temperature at Greenwich exceeded 75°, and on June 5 the thermometer registered 84°, which is 1° warmer than any previous reading on the corresponding day since 1841. A heavy thunderstorm occurred in and around the metropolis on May 31, when the rainfall at Greenwich measured 1·0 inch and at Epsom 2·86 inches, of which 2·44 inches fell between 5.20 p.m. and 6.10 p.m. The summary of the weather for the week ending June 3 issued by the Meteorological Office shows that extreme temperatures of 80° and above occurred during the period in nearly all parts of Great Britain, whilst the mean temperature for the week was largely in excess of the average over the entire kingdom, the excess amounting to 9·9° in the west of Scotland to 8·4° in the north-west of England, and to 8·2° in the south-west of England. The bright sunshine exceeded 70 per cent. of the possible duration in nearly all districts. May was exceptionally bright and warm, and at Greenwich the mean temperature was 5° above the normal, whilst on fifteen days the shade thermometer exceeded 70°, and on five days towards the close of the month the thermometer in the sun's rays exceeded 140°. The aggregate rainfall for the month was 1·88 inches, of which 1 inch fell on May 31, and in all rain only fell on nine days. The duration of bright sunshine was 212 hours, which is twenty-five hours more than the average.

The death is announced of Dr. J. C. Oman, author of several books on Indian customs and beliefs, at seventy years of age. From *The Times* we learn that in 1877 Dr. Oman joined the staff of the Lahore Government College as professor of natural science. In the Punjab capital, where he remained for twenty years, he won the esteem and regard of a great number of Indians of all castes and creeds by his sympathetic interest in their doings. When he retired from the Government service he was appointed to the principalship of the Khalsa (Sikh) College at Amritsar, and held the position for two years. His first book, "Indian Life, Religious and Social" (1889), was also, in a much revised and enlarged form, his last, for three years ago it was again issued under the title of "The Cults, Customs, and Superstitions of India." Among his other works are "The Great Indian Epics," which was included in Bohn's Standard Library, "Mystics, Ascetics, and Saints of India," and "Brahmans, Theists, and Muslims of India." Dr. Oman was a Fellow of the Linnean Society; and in recognition of his contributions to Indian ethnology, the degree of D.Litt. was conferred upon him by the Punjab University.

In connection with the recent discovery of remains of Palæolithic man in Jersey, the elaborate monograph by MM. M. Boule and R. Anthony on the skull found at La Chapelle-aux-Saints, published in the March-April issue of *L'Anthropologie*, is of more than ordinary interest. The morphological characteristics of this specimen are very remarkable, and in its simian type it is intermediate between man and the anthropoids. The writers thus record the result of their examination:—"L'encéphale de l'Homme fossile de la Chapelle-aux-Saints est déjà un encéphale humain par l'abondance de sa matière cérébrale. Mais cette matière manque encore de l'organisation supérieure qui caractérise les Hommes actuels."

The question of the existence of that strange birth rite known as the Couvade among the Basque race has been again raised in correspondence in the March-April issue of *L'Anthropologie*. It is now denied that any word in the Basque language describes the practice, which is said to be opposed to the national family system. On the whole, while the extent of the area in which the practice has been alleged to prevail may have been overstated, its existence in certain districts seems to be certain. In view of the rapid modification of national customs now in progress, the writer with some force appeals for a complete re-examination of the question so far as it affects the Basque people.

The July-December (1910) issue of the Journal of the Royal Anthropological Institute, which has recently made a rather belated appearance, is full of interesting matter in connection with the problems of early man. Prof. Boyd Dawkins issues his Huxley lecture on the arrival of man in Britain in the Pleistocene age, in which he confirms his original theory, published in his book on "Early Man in Britain," issued in 1880. He still believes that the cave men have handed down their culture to the Eskimo by means of the post-Glacial hunters in northern Asia. He now so far modifies this theory as to suggest that the facts do not, as he originally supposed, imply identity of race; it may have been brought about by tribes of different race. This must, he imagines, remain an open question until we have more evidence than we now possess of the Palæolithic hunters of Siberia, as well as more evidence from the caves of Europe.

In the July-December (1910) issue of the Journal of the Royal Anthropological Institute Dr. J. H. Anderson, a promising recruit to the school of physical anthropology in Australia, subjects to a searching analysis the existing formulæ for the estimation of cubic capacity in the living, and gives the results of a series of experiments on the actual capacity as determined by the displacement method. This he follows up by a paper of more general interest on the proportionate contents of the skull as demonstrated from an examination of forty Caucasian crania received from the metropolitan hospitals and benevolent asylums of the City of Melbourne. The results are that the brain volume probably decreases with advancing age; that the variation in the volume of the brain is compensated by

an inverse variation in the amount of cerebro-spinal fluid present; and that the dura mater does not vary in proportionate volume with increasing age, but remains constant with a volume from about 4·5 to 5·5 per cent.

In *The Malaya Medical Journal* for April (vol. ix., part ii.) Mr. E. D. Whittle directs attention to what is undoubtedly a description of sleeping sickness published in 1721. It is by a surgeon of the Royal Navy named John Atkins, who in that year sailed to the Guinea coast, and subsequently published a book, "The Navy Surgeon," in 1732, which in an appendix contains a chapter on "the sleepy distemper." This is probably the earliest account of the disease that has yet been found.

In the Bulletin of the Johns Hopkins Hospital for April (xxii., No. 241), Drs. Margaret and Warren Lewis record experiments on the growth of embryonic chick tissues in artificial media. The medium which gave the best results consisted of a mixture of Ringer's saline solution with a little agar and bouillon. In this a fragment of liver from a nine-day-old chick embryo enlarged to four times the original size in forty-eight hours, and the cells of the tissue radiated and migrated into the media and showed all forms of mitotic figures.

In a lecture delivered to the Manchester Clinical Society on the life-history function and inflammation of the appendix (and now issued in book form), Mr. E. Comer points out that appendicitis first became frequent in America at a time more or less contemporaneous with the preparation of flour in steel roller mills; in England the disease approximately dates from the introduction of this milled American flour, and among the blacks in America it similarly appeared when the milled flour became so cheap that it was simpler for them to buy their bread than to take the trouble to prepare their own. It is a curious coincidence if nothing more.

In a circular (No. 110) issued by the United States Department of Agriculture on food customs and diet in American homes, the author, Dr. Langworthy, points out how frequently erroneous statements regarding food and diet are made. Thus it is commonly said that the Chinese and other Oriental races live on a few handfuls of rice a day. Actually, rice with them takes the place of wheat with us as the chief source of starchy food, and is largely supplemented with other food-stuffs. Likewise, if due allowance be made for difference of body-weight, the American professional and business men and Japanese of similar employment consume a diet very similar in amount of protein and number of calories of available energy.

In No. 1828 (vol. xl., pp. 429–33) of the Proceedings of U.S. National Museum Mr. R. L. Moodie describes a third specimen of a salamander (*Eumicrerpeton parvum*) from the Carboniferous of Illinois in which the intestinal tract is preserved. The new specimen is larger and more developed than either of the other two. All three appear to be females, and not one shows any traces of branchiae. In the new specimen the intestine is longer and more convoluted than in the others, lying in five longitudinal folds and ending in a cloaca, near which are impressions of two glands, provisionally regarded as the terminations of oviducts. Eumicrerpeton is a member of the Branchiosauria. Mr. Moodie also describes a microsaurian from the same formation, referred to the genus Amphibamus, as *A. thoracatus*.

A note on the flowering of *Davidia involucrata* in Messrs. J. Veitch's Coombe Wood nursery, communicated by Mr. W. J. Bean to *The Gardener's Chronicle* (May 27), supplies some details regarding this unique monotypic genus, which is placed in the same family with Nyssa, but is not very closely related. The solitary pendulous flower, produced terminally on the branch, has two showy white bracts which subtend a conical receptacle bearing numerous stamens; arising out of the centre of the receptacle is an egg-shaped ovary surmounted by a few apparently barren stamens and several stigmas. The tree now flowering was raised from seed ten years ago, and has meantime reached a height of 14 feet; root pruning in the winter of 1909 may have induced premature flowering.

A memorandum compiled by Mr. F. Booth-Tucker with the object of promoting the more extensive planting of Eucalyptus trees in India has been issued as Bulletin No. 21 of the Agricultural Research Institute, Pusa. Failure in the past being attributed to the selection of unsuitable species, the chief object is to provide a list of suitable species and to indicate the conditions required individually. The species *amygdalina* is strongly recommended, both on account of its hardy nature and also for its economic value; *globulus*, the blue gum, requires a tolerably even climate such as that of the Nilgiris; *marginata*, jarrah, is only suitable for humid regions near the coast; *goniocalyx* is recommended for general forest cultivation.

In connection with the dispersal of fruits and seeds by ocean currents, the example most commonly quoted is that of the coconut, and the coconut palms growing on Krakatau since the eruption are attributed to this agency. This opinion has been previously combated by Dr. O. F. Cook, and he returns to the same charge in a recent number of the Contributions from the United States National Herbarium (vol. xiv., part ii.). His evidence is first directed towards refuting de Candolle's views pointing to the original home of the plant in the Old World, and controverting arguments, amongst others, are taken from a manuscript published in 1625, and the description by Cieza de Leon in the sixteenth century. Then, proceeding from the fact that all other species of Cocos and all species of closely allied genera are natives of South America, the author submits the argument that the coconut palm is a native of inland temperate plateau regions in South America, for which contention notes and illustrations are supplied of coconut palms growing in inland districts in Guatemala.

Geographical distribution and morphological modifications developed in species of Pelargonium form the subject of a paper by Dr. R. Knuth published in Engler's *Botanische Jahrbücher* (Beiblatt No. 103). The genus, comprising about 250 species, is almost entirely confined to Africa, where the chief centre of distribution lies in the extreme south-west. Annuals are few in number and confined to one section; they are characterised by having a short spur. Modifications are most pronounced in the perennials, and are mostly of a xerophytic nature. A string of tuberous thickenings—starch storing—are occasionally formed on the underground stem, and in *Pelargonium moniliforme* several such nodosities lie one above the other. In *P. squamulosum* an apparent collar is produced by the shrinkage of the cortex. In other cases the thickening occurs on the lower aërial portion of the stem, as in the section Otidea, and serves for water storage. Woody development of the petioles becomes most evident when the blade falls away and the petiole persists as a spine, as in *P. spinosum*.

DR. MILBURN has recently issued his reports on field trials with oats, mangolds, and nitrogenous manures carried out at various centres in Lancashire. The work is still in progress, but it was thought advisable to publish the available information for the benefit of farmers during the coming season. Demonstrations of this kind have been found of considerable benefit to the farmer, as they deal with problems that he cannot solve by himself, but that affect his profits considerably.

THE South African Association for the Advancement of Science issues each month *The South African Journal of Science*, containing original papers by its members, and notes extracted from other sources. No. 5 of the Journal contains an account by Messrs. Lundie and Hallack of seaweeds as manure, illustrated by several analyses of South African seaweeds. A new Cape thermal chalybeate spring is described by Mr. Rose; it contains 1·7 grains of ferrous carbonate and 25·7 grains of sodium chloride per gallon, and has a temperature of 129° Fahr. It is being exploited for curative purposes. There is also an article by Profs. Gilchrist and Thompson on the Cape klip-fishes (Clinus).

THE value of nicotine as an insecticide has long been recognised. A wash containing one ounce in ten gallons of water kills many of the worst insect pests that trouble the fruit- and hop-grower, including the apple sucker (*Psylla mali*), all kinds of aphides (Aphididæ), thrips or thunder-flies (Thripidæ), the larvæ of the winter moth (*Cheimatobia brumata*), and most young caterpillars. But unfortunately nicotine is too expensive for common use at present, and its price seems likely to rise, since it is now in demand for sheep-washes; the only hope for a fall in price is the more extended cultivation of tobacco. Experiments by Mr. Garrad at the Wye Agricultural College indicate that coarse varieties of tobacco can be grown here to produce nicotine at a rate much below the present market price.

The Agricultural Ledger, No. 3, issued from the Indian Government printing office, contains an account of the soya bean in India, by Mr. David Hooper, of the Indian Museum, Calcutta. Although the crop is not indigenous to India (its home being the extreme east of Asia), it has long been cultivated by certain hill tribes, mostly of Mongolian origin. Only recently, however, have any attempts been made at cultivation on the large scale, and it is not yet clear how far it is likely to succeed. Mr. Hooper points out several advantages of the crop: it is highly nitrogenous, and is therefore a valuable article of human diet in rice-eating countries; it can be made into certain food preparations—the Japanese make a soy-bean milk, a soy-bean cheese, and the shoyu sauce—and it also constitutes excellent cattle food, either in the unripened state as hay or as an oil cake. Numerous analyses of samples of the beans grown in India are given.

AN insect pest known as the froghopper has for some years been a source of serious trouble to the West Indian sugar planters. Not only does it cause a reduction in the weight of cane per acre, but it also adversely affects the quantity of sugar per ton of cane and the purity of the juice. The insect has now been identified by Mr. F. W. Urich as *Tomaspis varia*, Fabr., and a complete account of present knowledge of its life-history, its effect on the cane, and methods of control is given by Dr. L. H. Gough in Bulletin 67 of the Department of Agriculture for Trinidad. In the same publication Mr. Urich describes the cacao thrips (*Heliothrips rubrocinctus*, Giard), and gives some well-drawn coloured illustrations of the insect and the damaged pods and leaves.

AMONG various useful items contained in the meteorological charts of the North Atlantic and Indian Oceans for the month of June, issued by the Meteorological Committee, there is an interesting article on the phenomenon known as St. Elmo's Fire or corposants (*corpus sanctum*), the harmless luminous electricity of low intensity seen sometimes at night on ships' masts, &c., during unsettled weather. Many examples of authenticated experiences in olden and modern times are quoted, *e.g.* one by Columbus in October, 1495, during a severe storm. It was then assumed that the light emanated from the saint's body, and was a sure sign that the gale was at its maximum. In Dampier's time, 1687, a display was also accepted as a favourable omen, but in this case proved to be misleading, as the force of the wind continued to increase. The phenomenon is not unfrequent on land; it was quoted by Cæsar and others. On the summit of Ben Nevis the observatory was at times ablaze with it; the observers were not in any way inconvenienced, except by a slight tickling sensation in head and hands. Its behaviour furnishes an illustration of the elementary principle relating to the action of points on electrified bodies.

As an abstract from the *Jahrbuch de Hamburgischen wissenschaftlichen Anstalten*, vol. xxvii., we have received a brochure in which Dr. B. Walter describes and discusses a number of photographs of lightning. These photographs were taken in pairs, simultaneously, one plate being exposed in a stationary camera, the other in a camera which was moved by clockwork at a known rate. In the case of a single discharge, both plates register, of course, the same form, but in the frequent event of several subsequent flashes travelling down the lane of air ionised by the first discharge, the several flashes are seen separately; knowing the rate of angular motion of the moving plate and the focal length of the objective, it becomes a simple matter to determine the intervals of time separating these several flashes. On the five plate reproductions accompanying Dr. Walter's paper, such multiple flashes, sometimes occurring with single discharges from the same cloud, are clearly shown. For one of the sets of multiple discharge shown Dr. Walter finds that the time-intervals between five flashes taking the same path were 0·038s., 0·110s., 0·163s., and 0·080s., making a total duration of 0·391s. for the whole discharge. Dr. Walter considers a number of such cases, and deduces valuable results concerning the nature, intensity, and duration of the various forms of discharge.

THE special facilities which Prof. Raoul Pictet possesses in his laboratory at Berlin for carrying out experiments on low temperatures justify the interest with which the account he gave of his work at the meeting of the Royal Society of Arts on May 17 has been received. The experiments cover a wide field, but they centre round the fact that chemical processes which take place with freedom at ordinary temperatures are completely stopped at low temperatures, and for each process a temperature can be found for which it is just possible for it to occur. The determination and tabulation of these temperatures would, in the opinion of Prof. Pictet, constitute an important advance towards a dynamical theory of chemical processes. Such a theory, he points out, was published by him in the *Archives des Sciences phys. et Nat.* thirty-two years ago. It is founded on the definition of temperature as the mean amplitude of the vibratory oscillations of the molecules of a body, and of specific heat as the mean attraction of the body on the molecule. By means of these definitions he arrives at the conclusion that all physical and chemical phenomena can be accounted for by the existence of two distances apart at which two attracting masses will be in

stable equilibrium, and a third intermediate distance at which they are in unstable equilibrium. As Prof. Pictet's definitions differ so materially from those generally accepted at the present time, and his method of deduction is not very conclusive, or even at times clear, the theoretical portion of his address falls far behind the experimental in point of interest and importance.

THE launch of the *Titanic* took place at Belfast on May 31, and forms the subject of an illustrated article in *The Engineer* for June 2. The arrangements for launching were similar to those of the *Olympic*, and the ship took sixty-two seconds from the first movement until she was afloat. The launching weight was 25,000 tons. The hydraulic rams fitted in order to start the ship were not requisitioned. We understand that the *Olympic* has completed most satisfactory trials, and has been handed over to her owners a month before her time.

Engineering for June 2 contains an illustrated description of the yacht *Progress*, fitted with 100 indicated horse-power gas engine and produced and owned by the Empire Oil Engine Syndicate, Ltd., of London. Owing to the cost of oil fuel in many parts of the world, it seems certain that marine internal-combustion engines must be capable of using gas derived from ordinary coal. The engines of this yacht are on the two-cycle double-action principle, driving the propeller direct without the interposition of any gearing. The gas supply is from a suction producer, which has been worked with anthracite, with coke, and with coalite. The patentees are convinced that their accumulated experience will enable them to supply a producer capable of working satisfactorily with ordinary steam coal. The engines are so arranged as to secure great ease in manipulation; as instancing the handiness of the engines, it may be stated that, on coming out of dock on one occasion, twenty-six different movements were made in the course of twenty-one minutes. The time taken to reverse has been found to be from three to four seconds after the order is given. It is intended to build a second engine to develop from 350 to 400 horse-power, and a corresponding gas plant, in both of which a number of improvements in detail will be embodied. This plant will be fitted on board a vessel of the commercial type.

A "GRAPH TEMPLATE," designed by Mr. J. T. Dufton, by means of which standard rectangular hyperbolas and parabolas of large size can be drawn readily on squared paper, has been put upon the market by Messrs. Macmillan and Co., Ltd. The price of the template in transparent celluloid, with instructions, is 6*d*. net, and in nickel-plated metal 3*d*. net.

By a printer's error, the inscriptions of the two illustrations from "Kearton's Nature Pictures" reproduced in last week's NATURE (p. 450) were unfortunately transposed.

OUR ASTRONOMICAL COLUMN.

NOVA SAGITTARII NO. 4.—Circular 164 of the Harvard College Observatory announces the discovery of yet another nova in the constellation Sagittarius. This object was found by Miss Cannon during a rapid comparison of various photographs of the Harvard Map of the Sky on Map 43. It appears on eleven photographs taken between May 22 and July 9, 1901, but no trace of it can be found on 148 other plates taken in 1892, 3, 5, 6, 7, 8, and 9, and each year from 1900 to 1910 inclusive; each of these shows the C.D.M. star $-27°12411$, of magnitude 9·7, with which the nova at its maximum was equal in photographic magnitude. The exact date of the nova's appearance cannot be fixed, but the greatest observed brightness was 10·3 on May 22, 1901, and it is not shown on a plate taken on April 10, 1901, although this plate shows a fourteenth-magnitude star 0·3′ south of the nova. The fluctuations of brightness appear to be somewhat similar to those of Nova Persei (2). It is of interest to note that seven novæ are now known to have appeared in the region covered by Map 43.

THE MECHANICAL PRODUCTION OF THE STREAMERS SEEN IN THE SOLAR CORONA.—In order to test the theory that the shapes of observed coronal streams may be accounted for on the assumption that they are the natural production of certain defined mechanical forces, Prof. J. A. Miller examined the excellent series of corona photographs now available at the Lick Observatory, and he publishes the results of his discussion in No. 4, vol. xxxiii., of *The Astrophysical Journal*.

If the streamers are formed of particles ejected from the sun under the influence of the solar rotation, of the attraction and of the radiant pressure of the sun, certain shapes should theoretically ensue, and the velocity and direction at any point of the stream can be calculated. Prof. Miller has done this, and finds that not only do the observed streamers largely conform with his theoretical results, but he is able to compute and draw theoretical streamers, for the conditions obtaining at any one eclipse, which agree with those actually observed. Various modifications occur, but may be accounted for by reasonable assumptions of modified conditions; for example, the particles at the end of a stream are probably finer than those at the base, and therefore the sun's radiant pressure would act more strongly on them, or it may be that the particles of a stream are moving in a resisting medium which is denser in the inner than in the outer corona, and each of these causes would produce the differences observed between the computed and the observed results.

THE GENERAL PERTURBATIONS OF EROS.—A lengthy discussion of the general perturbations of the planet Eros is published by Herr H. Samter in No. 4498 of the *Astronomische Nachrichten*. The author tabulates his results for the combined perturbations by Jupiter, Saturn, and Venus, which were easily determined by Hansen's method, and in further tables gives the results of the earth's perturbations and those of Mars.

DETERMINATION OF THE APEX.—From the study of 620 stars having large proper motions, Dr. A. Wilkens has made a new study of the position of the apex. The stars are given in the Wilkens catalogue of 620 stars between 29° 50′ and 35° 10′ N., for 1875, and the Leyden A.G. catalogue, and include 267 having proper motions of 0″–5″; 173, 5″–10″; 76, 10″–15″; 35, 15″–20″; and 69 greater than 20″ per century. They also include 233 stars brighter than 8·5, but mostly fainter than 7·5, mag., 282 between 8·5 and 9·0 mag., and 105 fainter than the ninth magnitude. The resulting value for the position of the apex is $A=286°$, $D=+37°$, which is in good agreement with most modern estimations (*Astronomische Nachrichten*, No. 4499).

THE SPECTRA OF COMETS.—Visual observations of the spectra of comets 1908 III. (Morehouse), 1909*c* (Halley), and 1910*a*, are recorded by Herr von Konkoly in No. 4499 of the *Astronomische Nachrichten*. Bands were measured at 561·0 $\mu\mu$, 544·0 $\mu\mu$, and 515 $\mu\mu$ in the spectrum of 1908 III. on September 18, 1908, their respective intensities being 0·4, 0·6, and 1·0; the same bands were seen on September 22, but the wave-length in each of the last two was 1 $\mu\mu$ less. The red end of the spectrum was much brighter than the violet, and of the band at 470 $\mu\mu$ there was no trace.

Halley's comet on February 12 and May 26, 1910, gave a faint spectrum in which the same bands, with slightly varying wave-lengths, were seen. With a larger instrument, two other bands at 586·0 $\mu\mu$ and 472 $\mu\mu$ were seen, and possibly a third at 482 $\mu\mu$. The bands were very bright while the continuous spectrum was abnormally faint. From nineteen separate observations, the wave-lengths of the bands in Halley's comet were found to be 586·0, 561·5, 543·7, 514·7, and 472·0 $\mu\mu$.

The spectrum of comet 1910*a* gave bands at 556·0, 537·0, 512·0, and 481·0 $\mu\mu$.

THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

Aboard H.M.S. "Encounter."

April 12, 1911.

MY last letter was concluded when the Tonga Islands came in sight, for I knew that as soon as we dropped anchor my time would be fully occupied. We have now been here ten days, so there is much eclipse matter to report. The approach to our destined spot, namely, Neiafu, was beautiful in the extreme. The numerous islands of various sizes which form this large group opened out one by one. Some amounted only to rocks sticking up out of the water, whilst others extended over several acres, and were densely covered with trees, the useful cocoanut palms towering above them. Every island was so luxuriant with this thick verdure that I began to think we should have to utilise some of the ground at the Neiafu village itself.

Hunga on our port side and Nua Papu on the starboard were the first two large islands we passed, and then we took a more easterly course and came to the large island of Vavau, with the conspicuous hill called Moungalafa ahead. We entered a narrow channel separating the island of Pangai Motu from Vavau. Passing up this channel, it looked as if further progress would be impossible. Right ahead were two pyramid-shaped landmarks at the foot of Kilikili, a hill 220 feet high, and here was the gate to the chief town Neiafu; the channel became still more narrow, until it looked as if the good ship *Encounter* would be too large to swing round to go through the small entrance. In fact, it was a case of turning a sharp corner to keep in the middle of the fairway. The manœuvre was splendidly made, and we slipped into this nearly land-locked harbour; looking back, one began to wonder how it had been accomplished, so invisible was the entrance.

Well, here we were at Neiafu at last. Our anchor was dropped at 3.40 p.m. on April 2, and before us lay a picturesque-looking island town, with numerous flags flying over the houses.

It was not long before the health officer, Dr. Anderson, pushed off from the shore, for he had heard the gun which is always fired as soon as a ship is seen coming into the harbour. He was pulled out to the ship by a crew of finely built Tongaus. It was noticeable that all, even the doctor, were covered with hundreds of flies, and these (including mosquitoes) I later found to be the most populous inhabitants ashore.

Dr. Anderson told us that "measles" had been passing through Vavau, and that there were still a few cases, one of them being a European who was in hospital. This news suggested that it would be policy to find a site for our eclipse camp somewhere out of the town. Dr. Anderson kindly placed the ground about his house at my disposal for a site for the instruments, but when I inspected it later in the afternoon I found that it was not large enough, and unsuitable for so large a party. In fact, when I was ashore I could see no site that was at once a favourable spot. Mr. Worthington and Mr. Cruickshank, who had preceded us from England to observe the eclipse, had already been on the island some three weeks, and we visited their living tents and eclipse site, which were in the heart of the village.

Before reaching Vavau I had carefully studied the chart of the region, and came to the conclusion that it was well worth while visiting the spot, marked as an Admiralty coaling station, about a mile from Neiafu. Here I thought we should be free from all the disadvantages of a native town. The same evening I dined alone with the captain, and we determined that this site should be inspected.

[1] Continued from p. 463.

Accordingly, next morning, April 3, the captain, Mr. McClean, Fathers Cortie and Pigot, and myself set off in the steamboat and landed up the boat passage near the coaling ground called Umuna. We found that part of the ground was fairly level, high up, and partially cleared, and that by cutting down only about six cocoanut trees and doing a small amount of scrub clearing we should have a first-rate observing station. It did not seem difficult either to find a place where our instruments could be landed, so while Captain Colomb returned to the ship to meet the Governor, Mr. McClean, Father Pigot, and I remained and explored the seashore for possible landing places. In most places there was a steep coral front, but at Bai bai we found an admirable spot, and very close to the site. Fortunately, the captain returned to the ground with the Governor while we were still making investigations. The Governor, who is a native, and communicated with us by means of a native interpreter, told us that the ground was Admiralty property, and that the native who used it as a garden was only a kind of caretaker. This made things easy, for we were then entitled to cut down the necessary trees and make any clearing that was required. Most suitable and

FIG. 1.—The position taken up by H.M.S. *Encounter* close to the Eclipse Station. The photograph was taken from the Hill Muikilekila, 180 feet high.

picturesque places for the guards' camp, the living tents for the shore astronomical party, and other spots for the captain's wife and the officers' wives, who were coming from Australia, could be seen at a glance. In fact, the site could not really have been a better one, and the soil on which the instruments were to be placed was sufficiently rigid and dried very hard. The result of this inspection was so eminently satisfactory to the captain, Father Cortie, and myself that the first-named decided to move the ship right up the harbour and lay her off the observatory site.

The same afternoon anchor was weighed, and we steamed slowly up this beautiful inland sea, dropping it again at the mooring mark, which had been placed in position by the navigating officer, Lieut. Hurst, as a result of his survey in the morning. A shore party, including officers, then went off to the site to get a general idea of the nature of the selected spot.

Tuesday, April 4, was a very busy day. Clearing the ground was at once taken in hand, and a path was cut straight down to the spot selected for landing the cases. Numerous natives came on the scene to clear away the yams, a kind of bread fruit, which were growing on the site. A party from the ship set to work to erect the living tents. The site for Captain and Mrs. Colomb's quarters, selected by the Governor, had been previously

cleared by the local authorities. Great signs of activity were being shown, for the Union Steamship *Atua* was due to arrive in the afternoon with the officers' wives and three members of my party, namely, Messrs. Brooks, Raymond, and Winklemann. Owing to the living accommodation on shore not being quite ready, Captain Colomb kindly permitted the latter three to remain on the ship that night. The *Atua* brought also a portion of the Australian party, namely, Messrs. Moors, Merfield, Holloway, Paradice, and Burne, the site of whose camp had been settled near the Catholic Mission Church at Neiafu.

Since we arrived it has been very hot. On shore it is comparatively cool up to about 7 a.m. The temperature, however, quickly rises after, and between two and four o'clock in the afternoon it is extremely hot, the thermometer being at a maximum about 3.30 p.m. The two self-recording instruments which I set up in the camp tell us the temperature and the humidity of the shade air. The daily curves of these are the reverse of each other, the temperature rising when the humidity is falling. This is very fortunate, for the humidity is always high and the shade temperature at a daily maximum of about 86°. The self-recording barograph I still keep in my cabin on board, and this is daily marking out the two small diurnal oscillations with a long secular wave extending over many days.

FIG. 2.—The shore party's tents on the east side of the hill on which is situated the observatory station. The marks from left to right when looking at the photograph indicate :—1. Brother McKeon, 2. Dr. W. J. S. Lockyer. 3. Mr. Raymond. 4. Mr. Brooks. 5. Lieut. Clover. 6. Mr. F. K. McClean.

Wednesday, April 5, was occupied mainly in bringing all the instrumental gear from the ship to the instrument tents ashore. A most effective method was adopted to obviate the difficulty of the rise and fall of the tide: a landing stage jutting out several yards was improvised, and the boats came alongside and discharged their cargo. Block and tackle and a stout tree at the top of the 20-foot sharp rise at the shore, coupled with the strength of several hale and hearty bluejackets, quickly settled the question of hauling the cases up the inclined spars. If the cases were not too heavy, two men with one case slung over a spar carried it to the camp, whilst if it were rather heavy the limber from the gun (which had been previously landed) and a team of bluejackets made short work of it all. Working from 8.30 a.m. to 11.30 a.m., and from 2.30 p.m. to 4.30 p.m., both Father Cortie's cases and mine were all transferred from the ship to the instrument tents. In this way eclipsing is made very easy.

Up to this time no cocoanut trees had been cut down, as it was desired to preserve as many as possible, for each tree brings in an annual income of four shillings a year and takes six years to grow to a bearing condition. However, four trees had to come down as a first approximation, and these were felled the same afternoon; it has only been found necessary at the time of writing to cut down five altogether. On Wednesday a record, so far as I am aware, has been broken in eclipse expeditions with a man-of-war, for the guards' camp ashore and the ship have been connected by telephone, most of the cable being under water; on previous occasions a signal station and flag waving was the procedure adopted. Until to-day, Messrs. Brooks, Raymond, and Winklemann of my party have been sleeping ashore, as the three tents were fully prepared. To-day two more tents were completed, so Mr. McClean and Mr. Anderson joined them, and I still remained on board at night. The row of seven tents and the large mess tent dotted among the cocoanut trees, and situated on the trade-wind side of the hill, forms a very pretty picture and a cool spot when one has been on the eclipse site for some time. Flies and mosquitoes are there, however, in abundance, and spiders, large and small, galore.

The dark-room lies in a cool shady corner near the living camp. This position was chosen as all water has to come from the ship, and most of it daily goes to the living quarters, so labour is saved. To-day the positions of all the large instruments were carefully pegged out, and parties were sent to skirmish for sand and deal coral for the pillars, which will be erected immediately. Mr. Brooks has been busy with his theodolite, laying out the north and south lines for the siderostats and the correct azimuths for the cœlostats. To-day a crow's-nest has been erected on a tall cocoanut tree overlooking the ground, so that our hard-working photographer, Mr. Winklemann, and his two assistants can secure a good view of the whole eclipse camp as it progresses daily.

After consultation with my party, I have decided to sleep on board at night, so as to be a link between the ship and the shore party. This I consider to be advisable, as we require so much material and help each day. To-night three sharks were swimming about the ship, and many lines with hooks and pork were over the sides to tempt these hated brutes. Although almost daily sharks are present, no catch has been successful yet. According to the statements made by the Europeans here, the Tongaus can call the sharks by uttering native words. We have not seen this put into practice, but there is yet time.

Daily we have quite a lot of small fracto-cumuli clouds moving slowly across us, but the weather is thoroughly hot and tropical. Those living here inform us that we are having rather abnormally fine weather, as was the case in Australia. The weather, therefore, seems to be abnormal in this portion of the southern hemisphere, and we are hoping that the fates will be kind to us when we come to eclipse day.

Every day the camp shows great signs of progress. Levelling, making concrete pillars, covering small huts with willerden canvas, and similar operations being in progress. On April 7 several parties who could be freed from the eclipse camp went off collecting for the "'ologies" specimens of coral, flowers, butterflies, fossils, shells, &c. This specimen collecting is taken up very keenly, and I hope to have a good selection to bring back. The navigating officer is leaving the ship next week with a diving staff for Nukualofa to help salvage the ss. *Bouveric*, which has piled up on a coral reef. The captain was asked whether the *Encounter* could assist, but in reply to his message to the Admiralty for instructions he was informed that he could only render assistance if it did not affect the eclipse parties. At our present site we are now entirely dependent on the ship, and most especially for water, so Captain Colomb has decided that Lieut. Hurst, the navigator, should go by mail steamer and do what he can with divers and

explosives. Lieut. Hurst was a volunteer for the time determination as observed by the cusps, so he has now been replaced by Lieut. Clover.

On the evening of April 7 Commander Mellor, Father Cortie, and I went ashore after dinner to Neiafu to inquire about Prof. Moor, one of the Australian party, who had an accident yesterday. It seems that after a hard day's work he went to bathe, and while undressing fell from the bathing platform into very shallow water on to coral. He not only cut the back of his head badly, but his back, and he was in bed suffering from concussion. He is now (April 12) progressing, but he is suffering with his sight, and may have to return to Australia by the next steamer.

FIG. 3.—Preparing concrete for the pillars. Sand, cement, and dead coral (the last-mentioned quarried from the top of the hill) were used.

After another hard day's work on Saturday, when good progress was made in all directions, Sunday was considered a day of rest. Mr. McClean and Mr. Brooks preferred to stay ashore, Mr. Raymond and Mr. Winklemann went to Neiafu photographing, while Mr. Anderson and I went off for a sailing picnic with some of the officers. We visited the famous "Swallows'" Cave; hundreds of swallows flew out as we rowed in. The cave is of considerable dimensions, and its upper portion is a mass of stalactites. One projects vertically upwards from a ledge on the side, and when hit with a boat-hook it gives out a beautiful low tone like a large bell. The water in this cave is very deep and clear, and when it was thought no sharks were about some of the party indulged in a bathe. Lunch was partaken on a small sandy beach a mile or so away in the presence of thousands of flies, and there I made a collection of several shells and seeds. On our return in the evening we again entered "Swallows'" Cave, as the sun was well round and shining nearly in it. The colours of the water were superb, but the heat and the innumerable mosquitoes and flies made our stay shorter than we intended.

On Monday (April 10) at 2 a.m. very heavy rain fell, but as there was little wind and my bunk was placed well in the middle of the quarter-deck, I did not wake. Every night many of us sleep on the quarter-deck or after-bridge, and we dine on the former also. The ward-room gets very hot after the day's sunning, and the ship is so kedged that the wind strikes the starboard side; the port side is therefore the sunny and leeward side. The temperature in my cabin, with scuttle open and electric fan working, varies during the day time from about 84° to 90° F.

Unfortunately, on Monday Mr. Brooks, while chopping a piece of wood with an axe, cut his left-hand thumb badly. Staff-Surgeon Milln soon stitched it up for him when he got on board.

In the evening, during dinner, clouds appeared in the east, indicative of vertical currents, very tall cumuli clouds with flat bottoms. The wind began gradually to increase from a slight zephyr to a cooling breeze, and became fairly strong about 9.30 p.m., and the rain came down in torrents. While thinking of those living ashore and the instruments, we had to rush to remove our bunks from the deck, for the awning was of no apparent use.

This shower gave one some idea of how it can rain here, although up to now we have experienced very little of it. I made up my mind, therefore, to prepare for all eventualities. Thus Tuesday morning was chiefly spent in digging trenches. Fortunately, the dark-room had previously been dealt with in this manner, and could not be washed out. That afternoon was the climax. Down the rain came again in torrents. Mr. McClean and I went round the camp to see that all was in order, and at the same time obtained a good idea of what to do in the future. Although these rain squalls may not be numerous, they are tremendously heavy when they do come, and one thickness of canvas barely keeps the rain out. Fortunately, the ship can supply a great number of small waterproof coverings, and I expect we shall indent for most of them. Even to-day (April 12) rain has been frequent, and prevented much opening up of instruments. The sky was completely overcast in the early morning, and all day blue sky has been rarely seen. Later in the afternoon we had another deluge; but now we are well prepared, and do not mind so much. The humidity here is very high, and everything exposed to the air quickly rusts, even keys in one's pockets.

FIG. 4.—The 6-in. prismatic camera in course of erection.

Nevertheless, we are all a very cheerful party, and the assistance from the ship is magnificent. This evening the *Tofua* is expected to arrive, bringing more of the

Australian party, namely, Messrs. Baracchi, Cooke, Dodwell, Kenney, and Beattie, and Mr. Short for Worthington's party. This is the last post until after the eclipse. We will do our best to keep the flag flying on that eventful day, but we must have a clear sky.

W. J. S. LOCKYER.

N.B.—The photographs accompanying this letter were all taken (with one exception) by Mr. Winklemann. They were printed by a bluejacket on board H.M.S. *Encounter*, as conditions were not favourable for the process ashore. This bluejacket is a volunteer for our photographic department, and a very valuable one. W. J. S. L.

PHYSIOGRAPHIC STUDIES IN THE FRENCH ALPS.

THE former of the two memoirs included in the publication before us is a report by MM. Flusin and Bernard upon an apparatus for boring into a glacier, devised by MM. Hess and Blümcke, the working of which they had studied on the Hintereisferner in the Austrian Tirol. As the scientific interest of this is at present more indirect than direct, we may pass on to the second memoir, "Etudes Glaciaires Géographiques et Botaniques dans le Massif des Grandes Rousses," by MM. Flusin, Jacob, and Offner.

The Grandes Rousses is a rather lofty and insulated range in the French Alps, which rises on the right bank of the Romanche, roughly north-east of Bourg d'Oisans. On its jagged crest, which runs approximately from N.N.E. to S.S.W., two peaks, though some distance apart, attain the same altitude—11,395 feet. Its western side descends more abruptly than the eastern, so the glaciers on the former are shorter and steeper than on the other. It is an island ridge of crystalline rock—granites more or less gneissoid, and schists—rising from a hilly district of Lower Mesozoic (chiefly Liassic) rocks, mainly, no doubt, a result of the second of the two great folding processes which have given birth to the Alpine chain.

First in order, to the west of the watershed between France and Italy, is the great mass of crystalline peaks which rise around the headwaters of the Vénéon—two of them, the Ecrins and Meije, exceeding 13,000 feet in height—and are linked by the Col du Lautaret to the mountains south of the Arc. Farther west is the range of the Grandes Rousses, and still farther in that direction, separated by another syncline of Mesozoic rock, comes that of the Belledonne, the highest peak on which attains 9781 feet. The Ecrins *massif* is probably an extension (though perhaps not a simple one) of the Mont Blanc axis; the Grandes Rousses and the Belledonne, a prolongation of that of the Arguilles Rouges, which has either bifurcated or raised up another earth-wave in front. But the Grandes Rousses *massif* affords evidence of a much more ancient system of disturbances, for two strips of Carboniferous rocks (as may be seen in the valley of the Romanche) are sharply infolded in the crystalline series—just as occurs in the valley of the Rhone and on the way from Vernayaz to the Tête Noire. The author attributes this folding to the Hercynian movements, though its strike is much more nearly north and south than east and west. It was, at any rate, succeeded by enormous denudation, for in this part of the Alps the base of the Mesozoic series may be seen resting on the denuded edges of these huge folds.

The report includes a study of the Alpine plants in the three regions or stages into which the range may be divided, and a very full account of the snowfields and glaciers. The snow-line, of course, varies in different localities, but the authors take 8720 feet as an average, which very nearly coincides with the limit of the *névé*, that is, where ablation balances accumulation, or expenditure just exhausts income in the matter of snow. This limit, they point out, rises as the altitude of a group increases, being about 650 feet higher in the Grandes Rousses than in the Belledonne, while in the eastern *massif* it overtops the former by 400 or 500 feet, a result which seems to call for explanation. Particulars also of the retreat of the glaciers are given, with maps and some interesting photographs; in short, the memoir is a most elaborate one, though we cannot forbear remarking that if a similar exhaustive treatment is applied to other parts of the Alps—and the practice seems to be growing—conscientious students will before long often have to choose between hours in a library and work in the field.

T. G. B.

[1] Ministère de l'Agriculture — Direction de L'Hydraulique et de Améliorations Agricoles—Service d'Etudes des Grandes Forces Hydrauliques (Région des Alpes)—Etudes Glaciologiques. Tirol Autrichien. Massif des Grandes Rousses. Pp. vi+112 + ix plates + ix panorama views (1909).

THE MOVEMENT OF SUBSOIL WATER.[1]

IN all densely populated areas the water supply is a matter of primary importance, especially where the rainfall is scanty, and where a large proportion of the supply is derived from shallow wells. Dr. W. F. Smeeth, of the Geological Department of Mysore, has prepared a report dealing with this subject, which is based upon observations made during the year 1909, so that it provides rather a basis for further study than a complete discussion of the subject. The Mysore plateau extends over some 29,400 square miles, and is composed almost entirely of gneisses, granites, and crystalline schists, which are more or less decomposed to a depth of from 50 to in some places as much as 100 feet; the upper 50 feet of this forms a reservoir which is fed by the rainfall, and will hold a quantity of water varying with the porosity of the materials, and from it the wells derive their supply. On account of the seasonal character of the rainfall the level of the water-table varies considerably, and from various considerations the author takes a zone of intermittent saturation having a mean depth of 10 feet, and an average porosity of 12 per cent., as representing the average conditions which occur.

The rainfall varies greatly, from 73·21 inches in the west to 21·27 inches in the east of the area, and from the average variation of the water-level in wells, compared with a ground water supply which is taken as equal to 10 per cent. of the variation in the water level in each district, a "percolation factor" is obtained. No river discharges are included, nor is evaporation determined in order to obtain an independent value of the amount accounted for by percolation, which by the method employed is given as from 19·9 to 66·7 per cent. of the average rainfall. The rainfall also differs considerably in type in different portions of the area, having a strongly marked maximum in July due to the south-west monsoon in the west, while in the east the rainfall of the north-east monsoon in September and October is more important.

Observations were collected so far as possible from all villages, and 2563 wells were recorded from which fairly representative deductions for the year under investigation were possible. The mean depth of the water from the surface varied from about 38 to 4 feet, the mean values for maximum and minimum depths being 30 and 18, while the mean variation in the course of the year was 12·4 feet, and 27·5 per cent. of the wells were reported as drying up during the year. The variations of level ranged from an average of 15·3 feet for shallow wells in which the minimum depth to water-level was under 10 feet, to 8·2 feet in those where it was over 40 feet. Details of the water met with in the Mysore mines is included, but not much is deducible from such information at present. A series of diagrams show the position of the maximum and minimum water-levels in the village wells observed, and it is clear that a large number of them do not reach the depressed water-table of the dry season, since the conditions are not realised by the well owners. Deeper and fewer wells are recommended with pumping where necessary, and a systematic distribution of the permanent supply so obtained. Further investigation is recommended for the seasonal variation of water-level in different districts has not been considered. While diagrams are abundant, maps of the region, whether topographical, orographical, or showing the distribution of the rainfall, are conspicuous by their absence, and render a satisfactory study of the report difficult.

Although the Nile and its system of canals provide most

[1] "Notes on the Underground Water Resources in Mysoer." By Dr. W. F. Smeeth. Pp. 69, plates 1–69. (Government Press, 1911.)

of the water needed by the population of Egypt, nevertheless many questions connected with the increase of population in towns and with intensive cultivation have lately directed attention to the position and the movements of the water-table in the alluvial plain of the Lower Nile. After some preliminary work in previous years, a more systematic investigation was started in Upper Egypt from Aswan to Cairo, in 1907–8, to obtain definite information. This has now been published in the form of a departmental paper by Mr. H. T. Ferrar, of the Geological Survey of Egypt.[1] Observations were made at 239 wells which were visited, and the water-level recorded an average of eight times during the twelve months from one flood of the river to the next; since no rainfall occurs to complicate the conditions, these data were sufficient to define with adequate accuracy the range and movement of the water-table in that year. The rock trough in which the Nile flows is largely filled by pleistocene sands and gravels, over which the alluvial deposits have been laid down, and into these the wells from which water-wheels lift water are usually dug down through the alluvium and into the underlying sands; from these wells most of the observations were taken. At many points the Nile itself has cut into these sandy diluvial deposits, or flows against them at the margin of the valley, so that the river water is in communication with both deposits. A series of diagrams show the variation of the water-level in each well throughout the year, and also the position of the water-table for each month at fifteen different points of the river. Slight differences due to variations in porosity, &c., are to be seen, but the whole gives a very clear picture of the movement of subsoil water. The lines for September and October show its rapid rise, after which the fall commences, being greatest between December and January and afterwards decreasing. In these later months there is often a slope towards the river, and an appreciable amount of stored water is then returned from the flood plain to the river. It would have been preferable if the observed values had been indicated on the diagrams and the depths of the wells drawn, as the curves do not show to what extent they are controlled by data without reference to the printed tables.

In subsequent chapters an attempt is made to compute the quantity of water which the alluvial plain can hold, 60 per cent. by volume being taken as the water absorbed by the soil, but measured discharges of the river and canals are not utilised, and the values obtained cannot be regarded as more than rough approximations. Data for determining the direction of movement are scanty; near the river, results vary greatly within short distances, and in villages any use of colouring matter in such investigations would arouse much hostility. A large amount of valuable data has been collected, which greatly increases our knowledge of the water in the Nile valley, and must be of the greatest value for agriculture and for public health. The wells of the flood-plain are grouped into those of the river margin which are immediately affected by its changes of level, those of the plain which have an annual rise and fall about a month and a half after that of the river, and those close to the desert margin where the range is comparatively small. Further investigation on the same lines has been carried on since in the delta, which will be published in due course, forming a study of much value which, it is to be hoped, will be continued in the future.

[1] "The Movements of the Subsoil Water in Upper Egypt." By H. T. Ferrar. (Cairo: Survey Dept. Paper No. 19, 1911.)

THE ROYAL OBSERVATORY, GREENWICH.

MR. DYSON'S first report—as Astronomer Royal—was read at the annual meeting of the Board of Visitors held at Greenwich on June 2, and covers the year ended May 10. Below we give a brief summary.

The transit circle was employed for the usual observations and for the observation of stars of magnitude 9·0 and brighter between +24° and +32° north declination. The latter research, commenced in 1906 with the intention of securing five observations of each star, includes some 12,000 stars, and about 48 per cent. of the observations were completed at the date of report.

From the transit-circle and altazimuth observations of the moon's limb and Mösting A, made during 1909, the mean error of the moon's tabular place was found to be −0·423s. in R.A. and −0·53″ in N.P.D.; from ninety-eight observations with the transit-circle, the mean error in R.A., for 1910, was found to be −0·543s.

A new mercury trough has been added to the altazimuth. It is carried on iron rails quite isolated from the floor, and the steadiness of the star images has become greatly improved.

Values for the moon's parallax have been obtained from the Cape-Greenwich observations of Mosting A, made during 1905–10, and the probable error of the result, so far as it is independent of the earth's ellipticity, is ±0·06″. For values of $1/e$ ranging from 293 to 300, the correction to Hansen's value of the parallax ranges from +0·53″ to +0·12″; the combined results give +0·44″ as the correction and 294·5 as the value of $1/e$.

Bimonthly investigations of the R–D discordance revealed a nearly constant discordance, amounting to 1·14″, in the yearly mean, which changes sign when the instrument is reversed, and although the object-glass has been remounted, the cause of this has not yet been discovered.

The mean error in R.A. of the moon's tabular place for 1910 is −0·59s. from meridian observations of the limb and −0·55s. from those of Mösting A.

The reflex zenith tube observations for 1906–9, discussed by Mr. Eddington, give results in fair accordance, on the whole, with those published by Dr. Albrecht for the International Latitude Service.

About 600 double-star observations were made with the 28-inch refractor, including observations of 110 pairs under 0·5″ separation and 153 pairs between 0·5″ and 1·0″.

In the 30-inch Thompson equatorial the mirror, last silvered in February, 1910, is still in good condition owing to the cover having been made air-tight by a band of pure rubber. This instrument was employed in photographing Saturn and its ninth satellite, comets 1909*c* and 1910*b* and *e*, and some of Herschel's nebulæ, the latter for identification and position determination.

The 26-inch refractor was chiefly employed in the photographic determination of the parallaxes of stars in the Greenwich astrographic zone, Kapteyn's method of exposures on the same plate at intervals of six months being followed.

As the southern declination of Jupiter made observations at Greenwich impossible, the director of the Helwan Observatory undertook to continue the observations of J viii, and eight photographs, taken on eight nights, have already been received at Greenwich for measurement. Approximate measures of the first two photographs of the satellite indicate that the Cowell-Crommelin ephemeris is only 20″ in error.

Since November, the Greenwich astrographic telescope has been employed in the photographic determination of the magnitudes of stars given in the two published volumes of the Greenwich zones, Pickering's plan of polar sequences being employed.

An interesting investigation now being carried out at the observatory is the enumeration of the stars of different magnitudes on the photographs of the whole sky taken by Mr. Franklin-Adams, who is bearing the cost. Twenty-six plates, covering the sky between the North Pole and +53°, have been dealt with, and 42,284 stars counted. The greatest number counted on any one plate (in twenty-five 20′ squares) was 5138, the least 301.

The Dallmeyer photoheliograph is now housed in the dome of the old altazimuth, where one quarter of the original dome was cut away and a corresponding sector fixed permanently in the north, so that the large dome-aperture thus secured is easily closed by bringing it under the fixed sector. For 1910 the solar photograph record is complete, the ninety gaps in the combined Greenwich and Cape series having been filled by photographs received from the Dehra Dûn and Kodaikánal observatories in India. Since the beginning of May, one of the photoheliograph observers has attended from 7 to 9 a.m., thus adding two hours to the period of observation, and also securing better results.

The mean daily spotted area of the sun's disc in 1910 was less than half that of 1909, and during the five months ended March 31, 1911, the disc was free from spots on sixty-seven days. During the rapidly approaching minimum the direction of the sun's axis is to be determined

from the thirty-seven years' observations now available.

The principal results for the magnetic elements in 1910 were:—

Mean declination	15° 41·2″ West.
Mean horizontal force	0·18532 (C.G.S. units.)
Mean dip (with 3-inch needles) ...	66° 52′ 37″.

There were no days of "great," and only six of "lesser," magnetic disturbances.

The mean temperature for 1910, 49·7°, was 0·1° above the 1841–95 average, but the sunshine recorder showed a deficiency; July provided only about half the average number of hours of bright sunshine, and May was the only month when the amount was appreciably above the average. The rainfall, 25·93 inches, was 1·81 inches in excess of the 1841–95 average, and the number of "rainy days" was 175.

In the time department, the performance of chronometers is reported as satisfactory, and that of chronometer watches as exceptionally good. The increase of electrical devices on board ships having made the question of the magnetic disturbance of chronometers an urgent one, special experiments are being carried out with strong magnetic fields at the observatory.

THE HARD AND SOFT STATE OF METALS.

DR. G. T. BEILBY, F.R.S., delivered the second annual May lecture of the Institute of Metals on Friday, May 12, taking for his subject "The Hard and Soft States in Metals."

In the course of his lecture Dr. Beilby said that the hardening effect of cold working on ductile metals, and the softening effect of reheating, must have been known to the earliest workers in metals. To the general mind, the phenomena were sufficiently explained as being due to the "compacting" effect of hammering and the "opening up" effect of heat. The advent of scientific methods of inquiry led to the exposure of this fallacy, and to the discovery of new points of difference in a metal in the two states. The discovery that the polishing of all substances, even of those so hard or brittle as antimony or calespar, involves the transient liquefaction of a thin layer on the surface, led to the study of this subject from an entirely new point of view. In a pure ductile metal which has been slowly cooled from the molten state, the structure of the solid is completely crystalline, and the metal is in its softest condition. Any permanent deformation of the mass, whether by hammering, by rolling, or by wire drawing, hardens and stiffens it. The microscopic examination of the hardened metal shows that its original crystalline structure has been broken up and replaced by a new type of structure. If the hardened metal is raised to a sufficient temperature, the softness is completely restored *and the crystalline structure is also restored.* In the ductile metals the greatest degree of softness is always associated with well-developed crystallisation.

The composite character of the hardened structure, which in some cases resembles a bed of broken and distorted strata concreted or cemented together by a matrix, can only be explained by the presence of two constituents, namely, the broken-down remains of crystals and an amorphous or glass-like form of the metal by which the mass is so firmly cemented together that it has become vastly more rigid and mechanically stable than the crystalline structure. This amorphous or vitreous form of the metal stands in the same relation to the crystalline form as glass does to the crystalline silicates of which it is composed, or as the clear, vitreous "barley sugar" does to the ordinary crystals of the breakfast table.

The pure ductile metals cannot be obtained in the vitreous state by cooling, because their molecules retain sufficient mobility to enable them to marshal themselves in crystalline formation for a range of about 800° below the solidifying point. All the facts show, however, that when liquefaction is produced by mechanically induced flow the solidification is so rapid that the solid which results is in the vitreous condition.

Microscopic analysis of the surface skin produced by polishing a plate of calcite shows that the disturbance due to polishing has penetrated to a depth of one thousandth of a millimetre, and that the subsequent healing over of the disturbance has been so perfect that it can only be explained by the assumption that the transient liquefaction of a layer some thousands of molecules in thickness has occurred. It is evident that the conditions necessary to bring about liquefaction and solidification at the outer surface must equally exist within the substance at all surfaces of slip or shear, and the microstructure of the hardened metal confirms this view.

The direct bearing of these researches on the obscure subject of molecular structure in solids was pointed out, and a "pulsation cell" hypothesis of the three states of matter was outlined.

Prof. Quincke's "foam-cell" theory of solidification was referred to, and was applied to the explanation of certain observations made by Prof. Carpenter some years ago. In view of the possible bearing of this theory on questions of foundry practice, it was suggested that the Institute of Metals might offer a prize for the best research on the subject.

HYDRO-ELECTRIC PLANTS IN NORWAY AND THEIR APPLICATION TO ELECTROCHEMICAL INDUSTRY.[1]

THE physical configuration of Norway is remarkably favourable for the utilisation of the large number of waterfalls to be found on the seaboard of the mountain chains which almost cover the country, and through the valleys of which the enormous quantity of water precipitated from the western and south-eastern sea breezes finds its way as rivers flowing down to the sea. In the winter the rainfall takes the form of snow, so that the volume of water brought down by the rivers is at its greatest from May to July, when the snows melt on the mountains. To make use of the water-power, storage is therefore necessary, and for this the nature of the country is peculiarly adapted, being covered with lakes that have very contracted outlets, and which can be easily converted by damming into storage reservoirs. Thus in the watershed of Skien the natural water-power of 50,000 horse-power has been increased to an available horse-power of 375,000, while the Mösvand reservoir has increased the water-power of the Rjukan factories from 30,000 to 250,000 horse-power, with a capital outlay of only some 85,000*l.*

The total water-power in Norway has been estimated at from five to seven million horse-power, but as much of the country has not been hydrographically surveyed, this is probably too low an estimate. The power stations can supply power at from 22*s.* to 44*s.* per e.h.p.-year, and in some cases even for less; and as the quantities available are as high as from 50,000 to 100,000 horse-power for a single fall, the conditions are ideal for the development of electrochemical and electrometallurgical industries. Many such industries have already reached an advanced stage of development. Thus nearly 180,000 horse-power will be utilised this year in the manufacture of nitrates of lime, soda, and ammonia from the air by the Birkeland-Eyde process and the Badische Analin und Sodafabrik Company's process; about 60,000 horse-power are employed in the manufacture of calcium carbide, and other electrochemical and electrometallurgical industries absorb at present some 20,000 horse-power. Now that a suitable electric furnace—the Grönwall—has been designed for the smelting of iron ore, a furnace that has yielded excellent results on a practical scale, electric iron and steel smelting is likely to develop largely in the near future, for Norway possesses extensive deposits of iron ore. Three plants, aggregating 16,000 horse-power, with provision for increasing to nearly 60,000, are now being erected at Hardanger, Arendal, and Tinfoss. Other ores, notably copper, nickel, zinc, will also possibly be electrically smelted at no distant date.

The second portion of the paper describes in some detail the various hydro-electric schemes now being developed in

[1] Summary of a paper read before the Faraday Society on May 2, by Mr. A. Scott-Hansen, of Christiania.

Norway. On the Glommen River, in the east, three falls are utilised. The uppermost, Kykkelsrud, yields about 40,000 horse-power, of which 10,000 kilowatts is transmitted at 60,000 volts (3-phase 50 periods) to Christiania, thirty-one miles away, and the remainder to Sarpsborg. At Sarpsborg occurs the lowest fall of the Glommen, and here there are two power stations—Hafslund, supplying 24,000 horse-power to calcium carbide works and for zinc smelting, and Borregaard, the output of 26,000 horse-power of which is utilised by the Kellner Partington Paper Pulp Company, Ltd., owning the largest works in Norway. The intermediate fall on the Glommen is at Vamma, where a dam is now in course of construction under considerable difficulties. This dam will have a height of 90 feet, and will be one of the largest in Europe. The power station will be in the centre of the river bed below the dam, and will yield some 70,000 to 80,000 horse-power.

A large number of the minor power stations in the south supply the towns with light and power. Among the smaller electrochemical works are the electro-iron and steel works at Arendal, the experimental nitrate works of the Badische Company at Christianssand, and nickel and aluminium factories near the same town. The nickel works refine nickel matte, and turn out about 400 tons of the pure metal per annum. At Gjössingfjord is Mr. Albert Hiorth's small experimental electro-steel works. At Vadheim, on the west coast, is a sodium factory, and at Trondhjem, in the north, carbide, ferro-chrome, and ferro-silicon are manufactured.

Another great power centre is in the Telemarken district n the south-east of Norway. The Svaelgfoss power station supplies 40,000 horse-power to the nitrate factory at Notodden at a voltage of 10,000, delivered without transformation. The four 10,000-horse-power machines—capable of developing 13,000 horse-power—are among the largest in the world. A power station now being constructed at Lienfoss will be able to furnish Notodden with a further 20,000 horse-power. The Tinfoss Works, also at Notodden, are intended to generate 15,000 horse-power, to be used mainly for iron and steel smelting.

The third of the great Norwegian falls is the celebrated Rjukanfoss waterfall on the Maaneely River. The Mösvand dam, above this fall, provides a reservoir of about 840 million cubic metres (tons) of water, and five miles below is another dam, forming the intake for the power station, situated 1000 feet below. A lower fall of about 1000 feet provides the power for a second station. Both of these power stations—the largest in Europe—will yield 140,000 horse-power, there being in each 10 units of 14,000 horse-power. The turbines, on account of the great height of the falls, are Pelton wheels. The construction of the dams, flumes, and power stations at Rjukanfoss was attended with great engineering difficulties, which are described in the paper. The power from these stations is transmitted through sixty copper and aluminium cables to Saaheim, where factories for the manufacture of nitrogenous products to employ from 2000 to 3000 persons are in course of erection.

The paper concludes with a description of the power plant at the Tysse falls, which consists of seven units, each of 4500 horse-power, and from which electric energy is transmitted at 12,000 volts to Odda, where it is used for the manufacture of calcium carbide and of cyanamide. Here again, on account of the steep, mountainous character of the country, great difficulties presented themselves, particularly in the drilling of tunnels 1320 feet above the fjord, and in fixing the flumes, some against a smooth precipice, with an inclination of 60°. The Tysse power station will eventually yield some 100,000 horse-power.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—At the last meeting of the council the following resolution was passed:—"The council of the University has heard with great regret of the death of Prof. Whitcombe, who for twenty-three years was professor of mental diseases at Queen's College, Mason College, and the University, and desires to place on record its appreciation of the valuable services he has rendered to the University."

Dr. Helen M. Wodehouse has resigned her appointment as lecturer in philosophy on being elected to the principalship of the West Riding of Yorkshire Training College.

At the forthcoming degree congregation, official degrees are to be conferred on Prof. C. E. Martineau (M. Com.), professor of accounting, and on Miss S. M. Fry (M.A.), the warden of the Hall of Residence for Women Students.

Bristol.—Mr. Herbert Bolton, curator of the Bristol Museum of Natural History, has been appointed reader in palæontology in the University.

The thanks of the council have been accorded to the Local Committee on Agricultural Development for passing the following resolution:—"In view of the valuable research work now being done in the University of Bristol in the interests of the cheese industry, and also in the investigation of plant diseases, this meeting urges that a substantial grant for a given period of time be provided by the Development Commission, to enable the investigations to be proceeded with until practical results are arrived at."

Cambridge.—An offer to contribute 200*l.* a year for the next five years to the Geographical Education Fund has been made by the council of the Royal Geographical Society, which has further granted an additional 100*l.* for the year ending Michaelmas, 1912. A private benefactor has also offered 100*l.* for the ensuing academic year. It is proposed that these offers be gratefully accepted by the University.

A lecturer in historical and economic geography, a lecturer in regional and physical geography, and a lecturer in surveying and cartography, will be appointed by the General Board for five years from Michaelmas. The two latter will be known as the Royal Geographical Society's lecturers.

It is proposed to confer the degree of Doctor of Letters, *honoris causa*, upon Prof. Wilhelm Dorpfeld, principal secretary of the Imperial German Archæological Institute in Athens; and the degree of Master of Arts, *honoris causa*, upon Mr. John Watson.

Oxford.—The following is the text of the speech delivered by Prof. Love in introducing Prof. H. L. Bergson for the degree of D.Sc. *honoris causa* on May 27:—"Adest Henricus Ludovicus Bergson, inter huius aetatis philosophos insignis, vir multis nominibus laudandus, doctrinae novae et singularis suasor, eiusdem variis in rebus probator, rationis sibi constantis et late patentis inventor, orationis vi lumine venustate pollens. Qui cum non solum mathematicam et scientiam naturalem, sed etiam litteras et philosophiam penitus hausisset, id consecutus est ut, si quis alius, ipsius scientiae rationes corrigere et quasi terminos statuere posset. Nova profecto eius est sententia, esse quaedam, velut durandi notionem, sine qua vita et libertas esse non possint, quae in scientiam physicam mathematicis fundamentis exstructam non cadant: nova etiam eius doctrina, esse quoddam cognitionis genus ipsi scientiae non obnoxium, quo usa mens ipsam veritatem capiat, et durandi, vivendi, mutationis, motuum naturam comprehendat. Hanc ad sententiam, cum multa alia, tum rationem Darwinianam exegit, qua de re magna controversia exorta est, cum multi multis in terris huic suffragentur, ii qui adhuc dissident eius acumen admirentur.

Sheffield.—Mr. Llewellyn Lloyd, assistant curator of the Museum of Zoology, has been appointed entomologist to the Sleeping Sickness Commission of the British South Africa Company, and is leaving England at once for northern Rhodesia.

The fourth holiday course and second nine months' training course in physical instruction for men and women at Silkeborg, Denmark, sanctioned by the Danish Board of Education, will commence respectively on July 31 and September 2. Particulars can be obtained from the principal, H. G. Junker, Silkeborg, Denmark.

A course of three lectures on "The Evolution of Coasts" will be given by Prof. Albrecht Penck, director of the "Institut für Meereskunde," Berlin, at Burlington House, Piccadilly, London, W., at 5.30 p.m. on June 27, 28, and 29. The following is an outline syllabus:—development of English coastal scenery; formation of

Romney Marsh, Chesil Beach, Plymouth Sound. The lectures are addressed to advanced students of geology of the University of London and to others interested in the subject. Admission is free, without ticket.

WE learn from *Science* that a Bill has been signed by which the Massachusetts Institute of Technology will receive 20,000*l.* annually from the State for ten years. By the terms of the measure, the institute will maintain eighty free scholarships to be apportioned among the forty senatorial districts of the State. The California legislature has passed a Bill, which has been recently signed, appropriating 5000*l.* for a soils laboratory building, equipment, and other improvements at the Citrus Experiment Station. The work of the laboratory is to be confined to the study of citrus soils. The legislature of Hawaii has voted 15,000*l.* for a new building for the College of Hawaii and 4000*l.* for maintenance expenses.

THE report has been issued (Cd. 5662) of the Departmental Committee appointed to inquire into the administration of (*a*) endowments the income of which is applicable, or is applied to or in connection with, elementary education, and (*b*) small educational endowments other than the above, in rural areas, the application of which to their proper purposes presents special difficulties; and to consider how far under the existing law it is possible to utilise them to the best advantage; and whether any, and, if so, what, changes in the law are desirable in the direction of conferring upon county and other local authorities some powers in respect of such educational endowments or otherwise. The committee makes a number of recommendations, which are summarised in the report under twenty-two headings. Especially important is the proposal that, subject to certain exceptions and modifications, county councils in their capacity as local education authorities under the Education Act, 1902, should perform the functions at present performed by the Board of Education with regard to the administration of the endowments within the terms of reference, that there should be an appeal to the Board of Education from any scheme made by a local education authority, and that the range of educational objects to which trustees may apply their funds should be widely extended. It is also recommended that the local education authority should have the same powers of demanding accounts and investigating the administration of charities as are at present exercised by the Board of Education, but that the Board of Education should have a concurrent power of demanding accounts, though trustees will no longer be under any obligation to render accounts to the Board. Certain of the suggestions are not made unanimously, and memoranda at the end of the report provide particulars of the points on which some few members of committee do not agree with the main recommendations.

ATTENTION has recently been directed to a somewhat anomalous situation which had come into existence during the last few years in connection with medical education. The General Medical Council exercises a supervising control over the standard of the tests required by the various qualifying authorities in this country. In the regulations published by the Council, students are required to study the preliminary sciences at an institution recognised by the council, and *after* passing an examination in general education when above sixteen years of age. The council requires no elementary science at all in the general education. These regulations, which are obviously designed to make sure that students shall not scamp their literary, for the sake of their scientific, education, and that they shall study elementary science under generous conditions, probably achieve their purpose satisfactorily for a certain class of student. But, since public schools are not recognised by the council as places where elementary science can be studied, they evidently do not meet the case of the very large number of boys who enter the medical profession from the public schools. The difficulty has been met in the past by the fact that those qualifying authorities most used by public-school boys have not conformed to the regulations of the council. For though termed "regulations," they are not legal requirements, but more in the nature of recommendations. Thus the Conjoint Board of London and the Universities of Oxford, Cambridge, and London, the professional tests of which are beyond suspicion, allow students to pursue the study of the preliminary sciences at the public schools. Hence a boy following the usual school curriculum, and working at elementary science as part of his general education, has been able to offer himself for examination in these subjects on leaving school at eighteen or nineteen years of age. Recently, however, an increasing number of boys have gone from public schools to the newer universities and other authorities where they have to conform to the requirements of the Council. To observe the regulations, these boys have had to study again the elementary science which they have already, in many cases, satisfactorily done at school. Representations have been made to the council by the public schools directing attention to the difficulty thus raised; and on May 29 last at the meeting of the General Medical Council a resolution was proposed by Sir Henry Morris to remove the disabilities from which public-school boys suffer by "recognising" the schools under certain conditions. This resolution was adopted by 24 votes to 5.

THE fifth annual Conference of the Association of Teachers in Technical Institutions was held at Southport on June 5. Mr. Barker North, of the Bradford Technical College, in his presidential address, said that during the year the membership of the association increased by more than 20 per cent., and branches were formed in Ireland and Wales. More than 50 per cent. of the full-time technical teachers of England and a large percentage of the part-time teachers are now in the association, which is the only organisation representing all grades of the profession. Many technical institutions, he said later, suffer from the unsatisfactory nature of the constitution of education committees, and he urged the co-option of experts to remedy the present lack of special knowledge. Mr. North gave a tabular statement from the recently published census of production which shows that the net output in the nine leading industries of the country rose with an increase in the percentage of salaried persons. This suggests that, within certain limits, the employment of a large number of skilled technologists would develop the industry into higher forms and increase productivity. The state of the chemical industries shows how fatal is the system of limiting the employment of research chemists. Referring to the reforms necessary in education, he argued for the closer affiliation of continuation schools with the higher institutions; the work of the former should be a real continuation of that of the primary schools, and in technical institutes and universities provision must be made alike for the rank and file of the industrial army and for their officers—the second type being evolved from the first by means of natural selection. The defects of the present system would be remedied by drafting the best of the evening students systematically into day courses and by concentrating them for the highest class of work in specialised institutions. Such institutions should be affiliated to form technical universities. On these lines, he thought, the development of the Imperial College should be carried out. The time is ripe, said the president, for the appointment of another Royal Commission, with broader terms of reference than those assigned to the present, so that the whole question of the organisation of higher technical education in this country may be subjected to an exhaustive inquiry. Papers were read by Prof. W. W. Haldane Gee and Mr. T. J. Burnett, and resolutions were adopted urging the formation of an Advisory Council on Technical Education, consultative committees of teachers, the representation of teachers on education committees, and advisory committees for juvenile employment.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, May 2.—Mr. James Swinburne, F.R.S., president, in the chair.—A. **Scott-Hanson**: Hydro-electric plants in Norway and their application to electrochemical industry (see p. 501).—Edgar **Stansfield**: Two simple forms of gas-pressure regulators. The two regulators described give a steady pressure, easily adjusted, not influenced by the rate of flow of the gas. They consist merely of an outer containing vessel into which water is

poured, and an inner cylinder open top and bottom containing a floating beaker to which a valve is connected. When gas is passed into the inner cylinder through the valve, the position of the floating beaker adjusts itself so that the pressure of gas rises until the valve just closes. —Dr. W. C. McC. **Lewis**: Internal, molecular, or intrinsic pressure—a survey of the various expressions proposed for its determination. If we consider an imaginary plane of unit area placed in any direction well inside a liquid mass, equilibrium across this plane is maintained by the balanced attractive and repulsive molecular forces, which we have reason to believe are of very great magnitude, amounting to hundreds, or even thousands, of atmospheres. The attractive force per unit area is defined as the molecular, internal, or intrinsic pressure of the liquid, and is usually denoted by the symbol K. The present paper is a survey of the various attempts which have been made to estimate the value of K for various liquids.

May 23.—Dr. R. T. Glazebrook, C.B., F.R.S., vice-president, in the chair.—Dr. Arthur L. **Day**: Recent advances in high-temperature gas thermometry. The paper reviews the work done in recent years to increase the range and accuracy of the temperature scale upon which the various methods of measuring high temperatures depend for their calibration.—Dr. J. A. **Harker**: The high-temperature equipment of the National Physical Laboratory. The paper dealt with the methods of construction and the use of the various forms of apparatus for the attainment of temperatures above 100° C. which have been designed at the laboratory during the past ten years.—H. C. **Greenwood**: The boiling points of metals. In view of the scanty and uncertain nature of our knowledge of these important constants, a general investigation of the question was greatly needed. The present experiments may be divided into three sections:—(1) A study at atmospheric pressure of the boiling points of a number of metals which are unaffected by carbon at high temperatures (antimony, 1440° C.; bismuth, 1420° C.; copper, 2310° C.; lead, 1525° C.; magnesium, 1120° C.; silver, 1955° C.; tin, 2275° C.). (2) A study at atmospheric pressure of the boiling points of some metals which readily combine with carbon (aluminium, 1800° C.; chromium, 2200° C.; iron, 2450° C.; manganese, 1900° C.). (3) The influence of pressures varying from 10 cm. of mercury to 50 atmospheres on the boiling points of bismuth, copper, lead, silver, tin, and zinc.—A. **Blackie**: The behaviour of silica at high temperatures. This communication gives an account of some experiments made to determine the effect of heat on the strength and devitrification of the opaque and transparent varieties of fused silica. A determination was also made of their relative coefficients of expansion at high temperatures.—Prof. Max **Bodenstein**: Methods of maintaining constant high temperatures. Three general methods are in use:—(1) By means of a vapour in equilibrium with its liquid. Suitable substances are only available for a moderate range of temperature, but a uniform temperature over a large volume is easily maintained. On the other hand, constancy of temperature over a long period cannot be relied upon. (2) A liquid heating bath controlled by a thermostat. For high temperatures the method is restricted by the difficulty in obtaining a suitable substance, although for moderate temperatures oil or paraffin in a suitably constructed bath are fairly satisfactory, and temperatures up to 350° can be maintained within 0·05° for several months if a sensitive gas regulator be employed. (3) For high temperatures air baths only can be employed. Tube furnaces heated electrically, either directly or by means of coils, are now exclusively used, but although a constant temperature is easily maintained, uniformity of temperature is more difficult of attainment. —M. Charles **Féry**: Stellar pyrometry. The temperatures of incandescent terrestrial bodies can be measured by reference to the laws of radiation, either the law of Stefan or the law of monochromatic radiations, but these cannot be applied in the case of stars, owing to the small amount of radiation. The author has therefore devised an instrument, based on Weiss's displacement law, according to which temperature is measured by an appreciation of the colour tint of the star. In the instrument described, the colour of an image of the star is compared with that of a standard lamp the tint of which can be varied. The pyrometer is standardised by reference to an electric furnace, an arc (3500° C.), and the sun (6500° C.).

Royal Microscopical Society, May 17.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—J. E. **Barnard**: A method of disintegrating bacteria and other organic cells. The author first mentioned that bacterial toxins were of two kinds, extracellular and intracellular. The former were excreted into the medium, *e.g.* beef broth, on which the organism was cultivated, so that by a process of filtration the organisms could be removed and the toxin was obtained in the filtrate, but the majority of pathogenic micro-organisms did not excrete their toxins, at least to any extent, and the toxins were retained within and formed integral parts of the cells of the organisms. One method of obtaining these toxins was mechanically to disintegrate the bacterial cell, so that the cell contents were expressed, and the apparatus described accomplished this. It consisted essentially of a containing vessel in which, by a suitable rotation of steel balls, the organisms were crushed. The principal conditions to be filled in such an appliance were:—(1) approximately every cell should be brought under the grinding action; (2) little or no rise of temperature should take place; (3) the disintegration should be carried out in a vessel which was sealed so that, when dealing with pathogenic organisms, none could escape at any stage of the process. These conditions were, in the main, complied with in the apparatus described. Experiments indicated that by this method the cell-juices were obtained unaltered, and so were suitable for investigation on the chemical composition and properties of the bacterial proteins and other cell constituents. Also that, after the grinding process had been carried on for a sufficient time, practically no cells remained which could be stained properly by any recognised bacteriological method, and which, therefore, could be regarded as whole cells containing a normal quantity of cell-juice.—James **Murray**: Third portion of a Report on the rotifera observed by the Shackleton Polar Expedition of 1909. This portion of the report dealt with the new species, &c., from the Pacific Islands, in which the author said that in Fiji fifteen bdelloid rotifera were collected, in Hawaii twenty-four. Ten species were common to the two groups. In Fiji two new species were distinguished, *Callidina pacifica* and *Habrotrocha nodosa*, the latter previously known as a variety in India and elsewhere. In Hawaii there were no peculiar species, but some very distinct varieties. In the various Pacific islands there have been recorded thirty-one species of bdelloids.

Zoological Society, May 23.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. J. Stuart **Thomson**: Alcyonaria of the Cape of Good Hope and Natal. The author dealt exclusively with the order Gorgonacea, and recorded nineteen species, of which six were described as new.—Dr. A. Hopewell **Smith** and Dr. H. W. Marett **Tims**: Tooth-germs in the wallaby (*Macropus billardieri*). The material upon which their observations were based had been kindly sent to the authors by Mr. Brooke Nicholls, of Melbourne. It consisted of three embryos of *M. billardieri*. The smallest specimen (allowing for the difference in size of the adults of different species) was considerably younger than that of any other Diprotodont previously examined. In the upper jaw they had identified six incisors, thus confirming M. F. Woodward's original statement. The functional incisors of the adult appeared to be the second, fourth, and sixth of the series. There were four premolars, of which the first, third, and fourth persisted. There was also one molar tooth. In the lower jaw, owing to the difficulty of interpreting the conditions, it was not certain whether there were representatives of five or six teeth in front of the premolars. Presuming there were five, the large functional incisor of the adult was the fourth of the series. As in the upper jaw, there were four premolars and one molar, the second premolar not fully developing. There were evidences of vestigial predecessors to the large lower incisor and to pm^4. The following points of histological interest were noted:—(1) The heaping up of the epithelium along the alveolar margins, a character often supposed to be peculiar to the ungulates. (2) The precocious development of the enamel. (3) The compactness of the stellate

reticulum of the enamel-organ. (4) The abundant evidence of blood-vessels within the enamel-organ, thus confirming the observations of Poulton and Howes in the rodents. The opposite opinion is usually held. (5) Some slight evidence in support of the fusion of enamel-organs. Such fusion has been recorded in the fishes and reptiles, but not hitherto in mammals.—Rev. A. Miles **Moss**: The Sphingidæ of Peru, based on studies of Lepidoptera, with special reference to the larvæ, made during a three years' residence at Lima.—Dr. R. **Broom**: The structure of the skull of cynodont reptiles. The author, after a study of all the available material contained in the British and South African museums, gave a detailed comparative account, illustrated by a series of figures, of the morphology of the skull in the chief genera of the Cynodontia, including Bauria, Nythosaurus, Cynognathus, Trirachodon, Gomphognathus, Diademodon, Sesamodon, and Melinodon. He also discussed in some detail certain peculiarities of the mammalian skull, apparently derived from a cynodont ancestor.—Dr. C. W. **Andrews**: A new species of Dinotherium from British East Africa (see p. 457).

Geological Society, May 24.—Prof. W. W. Watts, F.R.S., president, in the chair.—R. J. Lechmere **Guppy**: The geology of Antigua and other West Indian islands, with reference to the physical history of the Caribbean region. After noticing the work of former observers on the geology of Antigua, the author gives a brief description of the formations of that island, showing that it is divided into three principal regions:—(1) the volcanic (or igneous) region; (2) the central plain; and (3) the calcareous formation, the first-named being, according to previous authors, the oldest, as it is pre-Tertiary, and the others following in succession. The calcareous formation, hitherto considered the newest, contains fossils, of which the most remarkable is a species of Orbitoides. After a discussion of these formations, and especially of the evidence for the so-called "Oligocene" age of the calcareous formation, the conclusion is reached that this formation is the oldest, not the youngest, and is probably Eocene or older. The island was raised above sea-level by the development of the great Antillian dislocation, which is described, and divides each of the islands of Guadeloupe and Antigua into two parts, of which the eastern is calcareous and the western volcanic. In Antigua the central plain intervenes between the two parts, while in Guadeloupe they are only separated by a narrow channel. In support of this proposition, the physical features of Antigua are discussed, and it is shown that the island has not been submerged since the volcanic period.

Institution of Mining and Metallurgy, May 31.—Mr. H. Livingstone Sulman, president, in the chair.—C. O. **Schmitt**: Future economies in Rand reduction plants. The main idea permeating this paper is a defence of the stamp tube-mill combination, against which arguments have been adduced by other authorities, with the further argument that, if either component of this combination is abandoned in the future, it will be the gravity stamp rather than the tube-mill that will be replaced by a machine capable of producing a finer product at a reduced cost. Naturally, a chief point of this paper is to promote discussion on a matter concerning which there are two distinct schools of thought. The author points out in introduction that, if working costs remain at their present figure, the limit of profitable mining will be reached approximately at a vertical depth of 5000 feet in a period of time that can be readily estimated. To increase the depth at which profits may be obtained, and consequently the period of life of a mine, it will be necessary to reduce working costs and capital charges, the former being the factor as regards which most improvement can be effected. What is known as the "big mill" policy was introduced on the Rand with the view of reducing working costs, and gave satisfactory results within proper limits. The author proceeds to analyse the work accomplished respectively by the sorting and breaking plant, and the milling or crushing plant, and he urges that, in view of recent developments and exhaustive experiments made on a sufficiently large scale, the efficiency of the tube-mill when dealing with material of a fineness suitable to produce the best results will be an important factor in the lowering of reduction costs to meet increased expenditure necessitated by seeking ore at depth. A considerable amount of data has been collected for this purpose, much of it in the form of tabular matter and diagrams of typical flow sheets in modern practice, with the view of showing that double-stage crushing is a certain means of effecting marked economies in operating costs and securing better extraction.—A. C. **Hoare**: The roasting of complex ores in gold assaying. Opinion is divided as to the advisability of roasting before fusion when assaying complex gold ores, and though in consequence of experiments it is now established that there is no loss of gold by volatilisation when telluride gold ores are roasted, the volatilisation losses, if any, met with in roasting other complex ores have not been definitely established. The author therefore undertook this investigation with respect to sulphide ores containing iron pyrites, which after careful assay had a base sulphide, such as zinc blende, stibnite, cinnabar, or mispickel, added to them, so that the influence of the sulphide on the roasting could be determined by subsequent assay. The results of these experiments showed that there was no loss of gold in roasting low-grade ores containing zinc blende or antimony, but that there is a loss when the ores contain arsenic, cinnabar, or mispickel.—G. M. **Austin**: A prospector's method of gold assay. In this paper the author details the outfit necessary for carrying out assays in a remote district without the need of taking an elaborate equipment, and he furthermore gives the results of a number of tests made with the view of determining the degree of accuracy attainable by means of a comparatively simple outfit, using one of two methods of assay of which he gives full particulars.

Manchester.

Literary and Philosophical Society, May 9.—Prof. F. E. Weiss, president, in the chair.—Ernest F. **Lange**: Some remarkable steel crystals, coupled with some notes on the crystallisation of the iron-carbon alloys. The crystals were discovered by Colonel T. E. Vickers, C.B., in the cavity of the rising head of a large steel casting, and were preserved by him in view of the known rarity of the occurrence of such a mass of perfectly developed steel "pine-tree" crystals, as the crystalline structures of steel are usually allotrimorphic instead of idiomorphic, that is to say, their geometrical forms do not, except in very unusual circumstances, correspond with their internal crystalline symmetry. A photograph of the cavity was exhibited which showed the walls covered with pyramidal apices of the crystals formed in the liquid metal, and masses of crystals up to 14 or 15 inches in length pendant from the upper portion of the cavity, where they had slowly formed and elongated with the sinking metal with remarkably little interference and in exceptional circumstances of size of casting and casting head and slowness of cooling. Reference was made to the columnar structure of steel castings and ingots as cast, and to the fact that although steel ingots show such a strongly defined columnar structure, the experiments of Müller in Germany had shown that the interior of "bled" ingots was invariably smooth, and that ordinarily solidification proceeded in smooth parallel layers without intrusion of any crystal growths towards the interior. These steel "pine-tree" crystals had never been reproducible in a laboratory experiment, and the problems of the crystallisation of steel had been worked out by experiments upon the allotropic forms of the iron and iron-carbon alloys, the work of Stead and Osmond and Cartaud being specially mentioned for its laboriousness and ingenuity. The author illustrated the internal symmetry of the crystalline structures of various steels by lantern-slides showing the structures that had been obtained in some of his own experiments in the heat treatment of steel, some of which had led to the scientific control of certain metallurgical operations formerly guided by rule-of-thumb practice only.—Prof. S. J. **Hickson**, F.R.S.: *Osteocella septentrionalis*. Some pieces of a very fine pennatulid well preserved in spirit were sent to Prof. Bell by the Rev. J. H. Keen from 30 fathoms off Lucy Island, British Columbia. They were sent by Prof. Bell to the author for examination and report. The specimen was, when caught, about 2 metres in length, and possessed a long, hard calcareous axis reaching a diameter of 7 mm. in its thickest region. On comparing the axis with that

of the type-specimen of *Osteocella septentrionalis* from Burrard's Inlet, British Columbia, preserved in the British Museum, no doubt could be entertained that the specimen from Lucy Island belongs to the same species. Large pennatulids from the same waters similar to this in structure have been described by different authors under the names Verillia, Halipteris, Pavonaria, and Ballicina. There can be no doubt that most of these specimens belong to the same species, and the proper name for it by the rules of nomenclature is *Osteocella septentrionalis*. The paper contains some general account of the structure of Osteocella, but, apart from the characters of the axis, the most important character is the great development of fleshy substance on the ventral side of the rachis and the presence of ventral radial canals.

DUBLIN.

Royal Irish Academy, May 8.—Rev. Dr. J. P. Mahaffy, president, in the chair.—K. T. **Wang**: The differentiation of quaternion functions. Quaternion functions are considered which involve only one quaternion, the constants being scalars. The formula

$$dfq = f'q\,dq + (f'q.\mathrm{V}q - \mathrm{V}fq)\mathrm{V}(\mathrm{V}dq : \mathrm{V}q)$$

is obtained, where $f'(q)$ is the differential coefficient of $f(q)$ formed as if q was a scalar. Several examples are given, and also application to the operator $\lhd$ (defined by $d = -Sdq\lhd$).—I. **Arwidsson**: Some Irish Maldanidæ. The paper dealt with a small collection of polychaet worms belonging to the family Maldanidæ, collected in Irish waters. One new genus, Cæsicirrus, and two new species, *C. neglectus* and *Nichomache maculata*, were described. Both species had been found previously by various naturalists, but were erroneously identified.—G. A. J. **Cole**: Glacial features in Spitsbergen in relation to Irish geology. The paper arises out of the excursion made in connection with the International Geological Congress of 1910. The comparison of Spitsbergen with Ireland towards the close of the Ice age is rendered an apt one, both on account of the scale of the surface features and the proximity of the open oceanic waters through a large part of the year. The effect of frost action, and especially of "nivation-hollows," is pointed out as originating the recesses, which are ultimately converted into cirques. It is urged that in plateau areas, like those of the eastern part of the Ice Fjord and around Killary Harbour in Ireland, cirques arise by the notching of the plateau edges below the snow-line. The Irish cirques, it is argued, belong to a late stay in the glaciation of the country. The possibility is discussed of the retention of lowland ice in the central areas of Ireland after regions to the east had become free. Interglacial phenomena may thus be traceable only on the margin of the Irish "ice-island," though pronounced in other areas.

May 22.—Rev. Dr. Mahaffy, president, in the chair.—James **Murray**: *Rotatoria bdelloida* (Clare Island Survey). No fewer than sixty-five species of bdelloid rotifers have been collected on Clare Island and the neighbouring mainland by Mr. Murray and his helpers, among them one species (*Habrotrocha hibernica*) new to science. The Irish bdelloids correspond closely with those of Scotland, only two species being, so far, unknown from that country.

Royal Dublin Society, May 23.—Prof. T. Johnson in the chair.—Prof. James **Wilson**: The inheritance of milk-yield in cattle. This investigation involved considerable preliminary inquiry, especially on the following points:—(*a*) the corrections to be made in short and prolonged lactations in order to bring them to the normal; (*b*) the allowances to be made for age; (*c*) in determining how far a cow's total normal yield might be estimated from her yield early in a lactation. These points having been determined, it was found that in full-sized breeds there are three grades of cows, a low grade giving from 450 to 600 gallons, a high grade giving from 1000 to 1200 gallons, and an intermediate grade giving from 750 to 950 gallons, and it was found, also, that the high and low grades are approximately "pure" strains, while the intermediate grade is a "Mendelian" hybrid between them.—Prof. T. **Carroll**: Experiments carried out at the Albert Agricultural Institution, Glasnevin, Dublin: an inquiry into the potato disease *Phytophthora infestans*. The experiments consisted of (*a*) placing in a field of potatoes a case protected by cotton-wool from the entrance of disease spores. The potatoes planted in the case belonged to a variety liable to disease; but the haulms and tubers of these protected potatoes were not attacked, whilst the surrounding unprotected crop was badly affected. (*b*) A portion of ground in which potatoes were growing was completely covered with cotton-wool immediately after the plants had made their appearance, when it was found that the tubers of the crop were completely free from disease, although the surrounding crop was much diseased, as were the haulms of the protected potatoes. (*c*) Between the drills (*anglice* ridges) holes were made 12 inches, 6 inches, and 3 inches deep, into which immature potato tubers were put, the haulms of the potatoes being placed over them. The potatoes from the 12-inch hole were free from disease; those from the 6-inch and 3-inch holes were one-third and two-thirds diseased respectively. Experiments with diseased tubers were also undertaken. (*a*) These were planted in a cool conservatory; disease did not appear in the plants nor in their tubers, although crops in the neighbourhood were badly diseased. (*b*) One of the tubers of this experiment planted in the conservatory showed no sign of disease up to September of the following year. The haulms of this plant were removed, and, the soil having been carefully removed from the tuber, diseased haulms from a plant grown outside were shaken over the exposed tubers after they had been sprayed with pure spring water. Almost all the tubers contracted the disease on their exposed surfaces. These and other experiments were undertaken in order to test whether the disease *Phytophthora infestans* is carried to the tubers of potato plants from the leaves through the stems, and with the object of proving the value of preventive spraying and suggesting its *raison d'être*.

PARIS.

Academy of Sciences, May 29.—M. Armand Gautier in the chair.—H. **Deslandres**: A simple explanation of the solar protuberances and other phenomena by very weak magnetic fields. By assuming the existence of a solar magnetic field analogous to that of the earth and also the ionisation of the gas of the black filaments and protuberances with the predominance of ions of the same sign. The consequences of this assumption are developed and compared with various experimental data.—Ch. **Lallemand**: A project for an international map and aëronautical fixed points. Proposals for a map for the use of aëronauts, enabling the position to be readily determined. The necessity for an international agreement is pointed out.—A. **Haller** and Ed. **Bauer**: The oximes and phenylalkylisoxazolones obtained with ethyl, methyl, and dimethylbenzoylacetic esters. The oxime of benzoylethylacetic acid described by MM. Hantzch and Miolati does not exist, and is, in fact, phenylethylisoxazolone. The esters of monomethyl, monoethyl, and dimethylbenzoylacetic acids, whatever their mode of preparation, give rise to substituted phenylisoxazolones when treated with hydroxylamine hydrochloride and alcoholic potash. The oximes, however, can be obtained by treating these esters in alcoholic solution with the chlorzincate of hydroxylamine (Crismer's salt).—Ch. Ed. **Guillaume**: The coefficient of the quadratic term in the formula of the expansion of nickel steels. The value of the coefficient of the quadratic term in the expansion is plotted against the percentage of nickel, the data from eighty-four alloys being utilised. The disturbing effects of chromium and manganese are discussed.—S. **Arloing**, M. **Fern**, and J. **Chattot**: The influence of the anæmia of the organs on the incidence of tuberculous lesions. Tubercle bacilli, varying in virulence, do not produce lesions in an organ deprived of circulation by aseptic means.—M. Godlewski was elected a correspondant for the section of rural economy in the place of the late M. Fliche.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1911. The results of observations on fifty-nine days are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Jules **Drach**: The determination of the asymptotic lines to the general surfaces of the third degree.—Lucien **Godeaux**: Linear congruences of

conics.—G. **Kœnigs**: The law of the curvatures of conjugated superficial profiles.—M. **Lemeray**: The principle of relativity and the forces exerted between bodies in motion.—H. **Larose**: The propagation of a discontinuity along a telegraph line with uniform loss.—G. A. **Hemsalech**: The air spectrum given by the initial discharge of the self-induction spark. It has been shown in a previous note that the spectrum of the initial discharge of a self-induction spark differs from that emitted by the oscillations, the spectrum having a large proportion of lines. A further study of these spectra of the initial discharge shows that the intensity varies inversely as the capacity of the condenser and directly as the self-induction of the discharge circuit. An increase in the capacity of the electrodes produces a strengthening in the line spectrum and a weakening of the bands.—André **Léauté**: The irregularities of the disruptive potential.—H. **Lioret**, F. **Ducretet**, and E. **Roger**: A self-recording telephone. A combination of a loud-speaking telephone and phonograph is described.—Pierre **Sève**: The measurement of magnetic fields in absolute value. The simultaneous use of the Cotton balance and the induction method described allows fields up to 15,000 Gauss to be measured with an accuracy of 1 in 1000.—E. **Baud**: The molecular heat of fusion.—A. **Tian**: The radiations causing the decomposition of water and the extreme ultra-violet spectrum of the mercury arc. The radiations decomposing water, forming hydrogen and hydrogen peroxide, are localised in the extreme ultra-violet at about 1900 Angström's. The light from a quartz mercury arc lamp determines this decomposition, owing to the presence of rays 1846, 1848, and 1851.—Georges **Dupont**: The catalytic isomerisation of acetylene pinacone. The synthesis of tetramethylketohydrofurane. The pinacone

$$(CH_3)_2.C(OH).C \quad C.C(OH).(CH_3)_2,$$

treated with an aqueous solution of mercuric sulphate gave, not the expected dioxyketone, but its internal anhydride, tetramethylketohydrofurane. The latter gives both ketonic and enolic reactions.—Emile **André**: A new method of preparing β-diketones. Ketones of the type $C_6H_5.C \quad C.CO.R.$ combine with amines forming compounds $C_6H_5.C(NR'R'').CH.CO.R.$ The latter, under the influence of acids, readily hydrolyse, forming the salt of the amine and the β-diketone $C_6H_5.CO.CH_2.CO.R.$ Examples are given proving the generality of the method.—P. L. **Viguier**: Tetrolic aldehyde.—V. **Grignard** and Ch. **Courtot**: The magnesium derivative of fluorene. In xylene solution at 135° C. fluorene reacts with ethylmagnesium-bromide, the magnesium compound

$$\begin{array}{l} C_6H_4 \\ | \\ C_6H_4 \end{array}\!\!\!>\!CH.Mg.Br.$$

being formed, several reactions of which are described.—M. **Battandier**: Experiments on the germination of an aquatic plant, *Damasonium Bourgaei*.—P. **Vuillemin**: Remarks on a disease of the Weymouth pine (*Pinus Strobus*). Reasons are given for supposing that this disease is not really a new one in France.—Pierre **Bonnier**: The monostatic capacity in aviators.—A. **Marie** and Léon **MacAuliffe**: The influence of the social medium on the development of height in women. The average female height increases with the social position.—L. **Le Nouëne**: The addition of a microphone apparatus to the ear trumpet for the relief of deafness.—Charles **Nicolle**, A. **Cuénod**, and L. **Blaisot**: Some experiments on trachoma (granular conjunctivitis). An account of attempts to transmit trachoma from human subjects to monkeys.—A. **Magnan**: The influence of the nature of the food upon the large intestine and cæcum of birds.—N. **Lehmann** and C. **Vaney**: The relations between the climatic conditions and frequency of the larvæ in the Hypoderma of the ox.—M. **Maisonneuve**: The fecundity of Cochylis.—Adrien **Lucet**: The influence of agitation upon the development of *Bacillus anthracis* cultivated in liquid media. If the liquid cultures of anthrax are kept agitated, the bacilli tend to assume the same form as in blood, and the yield in a given time is increased.—A. **Marie**: The development of a neutralising substance in the brain of mammals.—Eloy de **Stœcklin**: The oxydase properties of oxyhæmoglobin.—Gabriel **Bertrand** and Arthur **Compton**: The action of heat upon emulsin.—Stanislas **Meunier**: The *rôle* of biological force in the evolution of the terrestrial surface.—G. **Vasseur**: Western France during the Stampian epoch.—M. **Deprat**: The importance of recent epirogenic movements in south-eastern Asia.—L. **Cayeux**: Dislocations in the islands of Delos, Rhenee, and Mykonos (Cyclades).—Francis **Rey**: The presence of the Gothlandian in the plain of Tamlet, on the Algeria-Morocco border.—Charles **Moureu** and Adolphe **Lepape**: The ratio of argon to nitrogen in natural gaseous mixtures and its signification. This ratio has been determined for fifty-two natural gases from springs, and varies between 0·76 and 3·37, with an average of 1·15.—M. **Boudry**: A new method of utilising thermal waters at a distance from the spring.

CALCUTTA.

Asiatic Society of Bengal, May 3.—I. H. **Burkill**: Swertiæ chinenses quatuor novæ ex herbario G. Bonati. Four new Swertias from Yunnan are described, viz. *S. Bonatiana*, *S. Duclouxii*, *S. rosea*, *S. patens*; *S. patens* is a very marked species.—W. W. **Smith**: Note on *Sterculia alata*, Roxb., var. *irregularis*, a remarkable instance of leaf variation. The author directs attention to the wide range of variation in the leaf of this peculiar variety as represented on a tree in cultivation at the Royal Botanic Garden, Calcutta. Seedlings from the tree may vary like the parent.—W. W. **Smith**: A new Gentian and two new Swertias from the E. Himalaya. Descriptions of a small Gentian and two Swertias from Sikkim, *Gentiana pluviarum*, *Swertia ramosa*, and *S. Burkilliana*.—W. W. **Smith**: Plantarum novarum in Herbario Horti Botanici Calcuttensis cognitarum Decas. Descriptions of *Oritrephes septentrionalis*, *Senecio biligulatus*, *S. Lagotis*, *S. Kingianus*, *S. Chola*, *Saussurea fibrosa*, *S. Pantlingiana*, *S. Nimborum*, *S. Laneana*, and *Veratum shanense*. The first and last are from Burma; the others are from the Sikkim Himalaya.—Lieut. F. H. **Malyon**: Some current Pushtu folk-stories.—D. **Hooper**: The composition of Indian yams. Proximate analyses are given of forty samples of the tubers of identified species and varieties of Dioscorea, grown wild or cultivated in India. The food value of the best kinds is shown to agree with that of the potato. The poisonous principle, dioscorine, is described, and its presence or absence is recorded in the samples examined. The chemical changes that take place when the poisonous roots are treated with water to render them edible is shown by comparative analysis of the raw and prepared tubers.—D. **Hooper**: Some Asiatic milk-products. Peculiar forms of dried cheese, called *Karut* in Baluchistan and Afghanistan, and *Chema* in Tibet and Mongolia, are described, and the analysis of samples from Nepal and Quetta are recorded. They consist largely of casein, with more or less free lactic acid. Examinations are also made of Bengal curds, called *chhana* and *dahi*, the first being a rich cream containing more casein than ordinary cream, and the second being buttermilk undergoing lactic fermentation. *Karut* is prepared from fermented skimmed milk by pressing and drying the coagulated proteids.—Kashi P. **Jayaswal**: Elucidation of certain passages in I'tsing.—Biman Behari **Dey** and Hemendra Kumar **Sen**: Interaction of hydrazine sulphate with nitrites, and a new method for the determination of "nitritic" nitrogen. On attempting to prepare hydrazine nitrite by the double decomposition of barium nitrite and hydrazine sulphate, barium sulphate is precipitated, and the new salt appears to be formed at low temperatures, but readily decomposes. A systematic examination was made of the gases evolved, and it was found that by collecting the gases in an endiometer, nitrous oxide and nitrogen existed in the proportion of two to one. By calculating the weight of the gases evolved, the formation of monacid hydrazine nitrite is demonstrated according to theoretical equations. Nitrites of the alkalis, the alkaline earths, the heavy metals, and, in fact, nitrites in general, were decomposed in a similar manner, and the estimation of the volumes of residual gases indicated the amount of nitritic nitrogen formed in the reactions.—Prof. W. **West**, with notes by Dr. N. **Annandale**: Descriptions of three new species of Algæ associated with Indian fresh-water polyzoa. The algæ described are from the Western Ghats and Orissa, and represent the genera Tolypothrix, Dactylococcopsis, and Microcystis.

DIARY OF SOCIETIES.

THURSDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Practical Progress in Wireless Telegraphy: T. Thorne Baker.

MATHEMATICAL SOCIETY, at 5.30.—On the Multiplication of Dirichlet's Series: G. H. Hardy.—On the Range of Borel's Method for the Summation of Series: G. H. Hardy and J. E. Littlewood.—On the Convergence of Fourier Series and of the Allied Series: Dr. W. H. Young.—On some Two-dimensional Problems in Electrostatics and Hydrodynamics: W. M. Page.—On Groups of Linear Substitutions of Finite Order with Rational Coefficients: Prof. W. Burnside.

FRIDAY, JUNE 9.

ROYAL INSTITUTION, at 9.—Applications of Physical Chemistry to the Doctrine of Immunity: Prof. S. Arrhenius.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) The Transformation of the Moon's Latitude; (2) On the Progress of the New Tables of the Moon's Motion: Ernest W. Brown.—Measures of the Proper Motion Star Sh. 190: S. W. Burnham.—Further considerations relating to the Systematic Motions of the Stars: J. Halm.—Observations of Saturn's Ninth Satellite (Phœbe): Royal Observatory, Greenwich.—On the Detection of a New Element (Dysprosium) in the Solar Chromosphere: Alex. D. Ross.—*Probable Papers*: On the Law which Governs the Variations of SS Cygni: E. T. Whittaker.—Preliminary Results of the Photographic Method of obtaining Differential Places of Reference Stars: H. H. Turner.—The Hartmann-Cornu Formula: F. J. M. Stratton.—The Galactic Distribution of Gaseous Nebulæ: A. R. Hinks.

PHYSICAL SOCIETY, at 8.—The Lüders Lines on Mild Steel: W. Mason.—Exhibition of a Model illustrating the Passage of a Light Wave through Quartz: Dr. H. S. Allen.—Tables of Circular and Hyperbolic Functions for Complex Values of the Argument: A. Johnstone.—On the Measurement of Contact Differences of Potential: Prof. Anderson and J. G. Bowen.—Exhibition of some Gyroscopic Apparatus: Sir G. Greenhill.—A New Method of Approximate Harmonic Analysis by Selected Ordinates: Prof. S. P. Thompson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Acmæa from Bombay and Notes on other Forms from that locality: E. A. Smith.—Description of Three New Species of Operculate Land Shells from Grand Cayman Island: H. B. Preston.—Further note on Preoccupied Molluscan Generic Names and Proposed New Names: G. K. Gude.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the District of the Bergen Arches: Dr. C. F. Kolderup.—The Rock Formation of the Bergen District: Horace W. Monckton.

SATURDAY, JUNE 10.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

ARISTOTELIAN SOCIETY (at Corpus Christi College, Oxford), at 9.—Real Being and the Object of Thought: G. F. Stout.

MONDAY, JUNE 12.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Observations on Cotton and Nitrated Cotton. Part III.: H. de Mosenthal.—Methods of Testing Inflammable Gas and Vapour Detectors: A. Philip and T. Stenhouse.—A New Form of Automatic Detector of Inflammable Gases and Vapours: A. Philip and L. G. Steele.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some Explorations in the Himalayas: Dr. Arthur Neve.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

TUESDAY, JUNE 13.

ZOOLOGICAL SOCIETY, at 8.30.—On Antelopes of the Genera Madoqua and Rhynchotragus from Somaliland: Dr. R. E. Drake-Brockman.—On an Amphipod from the Transvaal: Hon. Paul A. Methuen.—The Somali Rhinoceros and the Nigerian Klipspringer: R. Lydekker.—A Contribution to the Ornithology of Western Colombia: C. E. Hellmayr.—The Subspecies of the Spanish Ibex: Prof. Angel Cabrera.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Saints of the Indus Valley: Major A. J. O'Brien.

ROYAL STATISTICAL SOCIETY, at 5.30.—Under the Crown: Sir J. Athelstane Baines.

MINERALOGICAL SOCIETY, at 5.30.—On Zirkelite from Ceylon: G. S. Blake; with Notes on the Crystallography of the Mineral: Dr. G. F. H. Smith; and on the Chemical Composition: Dr. G. T. Prior.—Note on some Crystals of Artificial Gypsum: Rev. Mark Fletcher.—The larger Diamonds of South Africa: L. J. Spencer.—Brecciation in Mineral Veins: F. H. Butler.—On a New Mineral from the Binnenthal: R. H. Solly.—Prehnite from the Lizard District: Arthur Russell.

FARADAY SOCIETY, at 8.—Allotropic Forms of Metals: Prof. Ernst Cohen.

WEDNESDAY, JUNE 14.

GEOLOGICAL SOCIETY, at 8.—On a Monchiquite Intrusion in the Old Red Sandstone of Monmouthshire: Prof. W. S. Boulton.—Notes on the Culm of South Devon. Part I., Exeter District: F. G Collins; with a Report on the Plant Remains: E. A. Newell Arber; and Notes on the Cephalopoda: G. C. Crick.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Diurnal Inequality of Barometric Pressure at Castle O'er, Dumfriesshire: Dr. C. Chree, F.R.S.—Rain Drop Experiments: S. C. Russell.—Investigation of the Electrical State of the Upper Atmosphere, August, 1910: A. J. Makower, Dr. W. Makower, W. M. Gregory, and H. Robinson.

THURSDAY, JUNE 15.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: A New Conception of the Glomerular Activity: Prof. T. G. Brodie, F.R.S.

LINNEAN SOCIETY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Report on River Investigation: Dr. A. Strahan.

FORTHCOMING CONGRESSES.

JUNE 28, 29.—Conference on Education and Training of Engineers. London. President: Mr. Alexander Siemens, President of the Institution of Civil Engineers. General Secretary: Dr. J. H. T. Tudsbery.

JULY 18-22.—International Association of Seismology. Manchester. President: Prof. Arthur Schuster, F.R.S.

JULY 25-28.—British Medical Association. Birmingham. President: Dr. H. T. Butlin, Pres.R.C.S.

JULY 26-29.—First Universal Races Congress. University of London. President: Lord Weardale. General Secretary: G. Spiller, 63 South Hill Park, Hampstead, London.

JULY 29-AUGUST 5.—Congress of French Geographical Societies. Roubaix. President: Prince Roland Bonaparte.

JULY 30-AUGUST 2.—Annual Meeting of the Swiss Society of Natural Sciences. Soleure. President: Dr. A. Pfaehler. Inquiries to Secretaries: Dr. Küng (German) and Prof. Brönnimann (French).

AUGUST.—Centenary of the Foundation of the University of Breslau.

AUGUST 12-18.—First International Congress of Pedology. Brussels. President: M. Alexis Sluys. Secretary: M. Vital Plas, 35 Avenue Paul de Jaer, Brussels.

AUGUST 13-20.—Prehistoric Society of France. Nîmes.

AUGUST 31-SEPTEMBER 6.—British Association. Portsmouth. President: Sir William Ramsay, K.C.B., F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 4-6.—Centenary of the University of Christiania. President of Festival Committee: Prof. Brögger.

SEPTEMBER 9-20.—International Congress of the Applications of Electricity. Turin. President of the Committee of Honour: H.R.H. the Duke of the Abruzzi. Honorary Secretary of the Committee: Signor Guido Semenza, Via S. Paolo 10, Milano International Secretary: Col. R. E. Crompton, C.B., R.E., Crompton Laboratory, Kensington Court, W.

SEPTEMBER 24-30.—International Congress on Tuberculosis. Rome. Address for inquiries: Honorary Secretary of the National Association for the Prevention of Consumption, 20, Hanover Square, W.

OCTOBER 2-7.—Third International Congress of Hygiene. Dresden. General Secretary: Dr. Hopf, Reichsstrasse 4, Dresden.

OCTOBER 15-22.—Tenth International Geographical Congress. Rome. President: Marquis Raffaele Cappelli. General Secretary: Commander Giovanni Roncagli, Italian Geographical Society, Rome.

DECEMBER 27.—American Association for the Advancement of Science. President: Dr. C. E. Bessey, University of Nebraska. Permanent Secretary: Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.

CONTENTS.

THURSDAY, JUNE 15, 1911.

RURAL DENMARK.

Rural Denmark and its Lessons. By H. Rider Haggard. Pp. xi+335. (London: Longmans, Green and Co., 1911.) Price 6*s*. 6*d*. net.

MR. RIDER HAGGARD'S book is the outcome of a recent visit to Denmark, made in order to inquire into the actual conditions of farming prevailing there, and particularly into the success of the small holders, who form so marked a feature of Danish agriculture. Mr. Rider Haggard's further object was to gather information as to whether such small holdings are likely to succeed better on the leasehold system that has been established in this country by the recent Act, or whether, as advocated by the other party in the State, it is essential for success that small holdings should be owned by their occupiers. Mr. Rider Haggard also wished to ascertain the working of the various forms of credit banks and State loans to farmers to enable them either to purchase their holdings or to provide working capital when they were already in occupation. For the last generation Denmark has been the standard example to all agricultural reformers of how the farming of a country can be made efficient by taking thought, either through the medium of cooperation or more directly by State aid. Denmark has to live by its agriculture alone, and it is well known that the productivity of the country, the wealth of its population, and the value of its exports have been raised to an astonishing degree during the forty years or more that have elapsed since the war with Germany; so that, despite many natural disadvantages, Denmark has been able to maintain its position as a free-trade country in face of the unprecedented competition from America, which has so severely shaken the status of agriculture in other European countries.

Mr. Rider Haggard went provided with the best introductions, and he reports, with the clearness and the power of description for which he is so well known, the impressions which he formed as he passed from one agricultural enterprise to another. For example, he tells us of the operations of a cooperative dairy, of a milk supply company, and of an egg export association; he visited one of the great capitalist farms worked by its owner, carrying more than 1000 cows, and earning a net profit estimated at 20,000*l*. a year. As a contrast, he also describes in detail the mode of working some of the State-created small holdings of about six acres each, and compares them later with other privately acquired peasant properties of from five to thirty acres.

In his survey education also bulks largely; the elementary schools, the high schools which take young men and women between seventeen and twenty-five for three months in the winter, the agricultural school proper, and the great central college at Copenhagen were all visited, and one cannot fail to be impressed throughout the whole of the book by the manner in which the success of the Danish farmer seems to depend upon the high standard of education he has reached, and his attitude towards the things of the mind.

Finally, Mr. Rider Haggard reports the substance of his discussions with various authorities on the particular questions about which he was making inquiries. For example, he shows that even in Denmark men are not agreed as to the value of small farms as compared with large, still less so as to the desirability of the State making loans and subventions in order to create a community of small farmers. After a general discussion of the present position of Danish agriculture, he emphasises the fact that the success of the small farmers, even the possibility of their existence, is dependent upon the way they have learned to work together, and the almost universal adoption of the form of cooperation in both buying and selling. Not only is cooperation necessary to enable the small man to buy somewhere near prime cost and to realise a due return for his produce, but the cooperative societies form the great medium for the technical education of the farmer. For unless men in a district have learned to act together it is impossible to deal properly with such questions as the improvement of stock and crops, the eradication of disease, &c.

Mr. Rider Haggard's book is extremely interesting reading, and though at times we may feel a little inclined to doubt whether his working knowledge of agriculture was quite sufficient to enable him to appreciate the real bearing on the situation before him, his book is most valuable because it is free from that indiscriminate laudation of the Danish farmer and his methods, which has been preached somewhat *ad nauseam* to the English agricultural community.

Mr. Rider Haggard has been too wise to suppose that an economic revolution can be effected in the English countryside by merely copying Danish methods, and he sees that any attempt to impose Danish organisation upon our farmers at the present time would only end in disaster. Organisations, methods, institutions, really count for little except in so far as they are the outcome of the spirit of the men and women who are working through them, and agriculture on a Danish model will be impossible here until we have a community possessing the same mental outlook. Mr. Rider Haggard rightly lays stress in almost every section of his book on the high pitch of education to which many of even the smallest occupiers of land in Denmark have reached, and again and again it comes out that this education is general and not merely technical. The Danish small farmers, even the Danish peasant or milkmaid, seek for education in order to become free and effective men and women, and it is almost incidentally that they learn certain other things which they can turn to direct pecuniary account. It is through education, and through an education founded on a respect of things of the mind, that cooperation has become possible there, and it has made so little headway in this country just because its immediate returns are but a small inducement to men who live in an atmosphere of distrust of the unknown and suspicion of all joint actions.

If for this reason alone, his insistence that the success of small holdings depends upon cooperation, and that cooperation ultimately depends upon education, we can most cordially recommend Mr. Rider Haggard's book to everyone who is interested, either directly or indirectly, in the welfare of the rural population.

THE SEWAGE PROBLEM.

Sewage Disposal. By Prof. L. P. Kinnicutt, Prof. C. E. A. Winslow, and R. W. Pratt. Pp. xxvi+436. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 12*s.* 6*d.* net.

THE economic solution of the important problem of sewage purification depends for its success on the careful application of engineering principles to the numerous physical, chemical, and biological changes involved. It is therefore with pleasure we find a volume devoted to the subject which is the result of collaboration between distinguished American representatives of chemistry, biology, and engineering, particularly so when each of the individual authors has had wide experience in the practice of sewage purification and disposal.

It is stated in the preface that this work was in progress before several of the recent publications on sewage purification had appeared; the authors, however, claim that there is still room for a general survey of the subjects with particular reference to the conditions of American practice. This claim is certainly justified by the careful way in which world-wide information in regard to the various methods of sewage purification has been collected, and by the admirable manner in which the subject-matter is presented.

From the point of view of American practice it is not surprising to find that separate chapters are devoted to the consideration of the questions of sewage purification or disposal by dilution, and of intermittent sand filtration. The former question receives thorough treatment, and the conditions necessary for the adequate purification of sewage discharged into waterways are discussed at length. Interesting examples are given of the self-purification of rivers receiving sewage. While this method of disposal is rendered possible in many cases in America by reason of the relatively large volume of the rivers, it is, of course, for obvious reasons, scarcely practicable in the case of inland towns in England.

The question of the preliminary treatment of sewage by the various tank processes, and also that of the disposal of sludge, is thoroughly dealt with in chapters iv. to vii., inclusive. Under the head of the septic process, the Hampton hydrolytic tank is described in detail, and the Emscher tank of Imhoff receives notice. The Hampton doctrine on the theory of sewage purification is given careful attention, and the authors' conclusion in regard to the relative value of this theory as compared with the views advanced by Dunbar will probably meet with general approval by those actually engaged in the work of sewage purification.

It is interesting to note that when discussing the bacteriology of intermittent filtration, no reference is made to the theory recently promulgated of direct nitrification of organic nitrogen, the authors evidently being in agreement with the generally accepted view of the preliminary formation of ammonium compounds.

In subsequent chapters is given a comprehensive survey of the question of the purification of sewage on contact beds and percolating filters respectively, illustrated by numerous examples of purification works in England, America, and on the Continent. The authors' review of the relative merits of the two systems of filtration may, in general, be commended. It is to be feared, however, that the quantities of sewage actually dealt with by percolating filters will be found on investigation to be considerably lower than those given in table lxxxv., especially when the time the filters are out of operation is taken into consideration.

Exception must also be taken to the authors' statements that the results obtained at Croydon, which are quoted on p. 372, afford an excellent idea of the comparative efficiency of contact beds and percolating filters.

These results give an entirely erroneous impression as to the possibility of contact beds, inasmuch as the purification mentioned of from 40 to 47 per cent., is certainly much below the results generally obtained when working at so low a rate as 46 gallons per cubic yard per day.

The concluding chapters are concerned with the disinfection of sewage and sewage effluents, and the methods of analysis.

In view of the present tendency amongst certain English sanitarians, it is important to observe that in the opinion of the authors, it has not yet been demonstrated that any electrolytic process for making chlorine at the sewage plant, unless free power is available, is as economical as the purchase of the ordinary commercial product.

This work can be thoroughly recommended to all interested in sewage purification, more particularly as the authors themselves do not dogmatise on the subject, but are successful in presenting in a lucid manner both the principles involved in the problem of sewage treatment, and the various views and theories which have been advanced by leading investigators. A clear statement of the present position of the subject is thus afforded. The value of the book is enhanced by the excellent list of references, which will be found of considerable use to those engaged in sanitary work.

EDWARD ARDERN.

FACT AND HYPOTHESIS IN BIOLOGY.

Lectures on Biology. By Dr. Curt Thesing. Translated from the second edition by W. R. Boelter. Pp. viii+334. (London: J. Bale, Sons, and Danielsson, Ltd., 1910.) Price 10*s.* 6*d.* net.

THIS book could be heartily recommended to readers who wish for a modern presentation of general biological discovery were it not for the pseudo-philosophical limitations which the author imposes upon each and every hypothesis that has been advanced to account for the facts. The arguments that

go to prove the truth of evolution are skilfully and attractively marshalled, but that is not the author's chief object. What he aims at is to show that the selection-hypothesis only applies to a limited field, that use-inheritance has its restricted place, and so on; in short, that all our explanations are partial, and that in none of them can we have complete confidence.

When we come to ask on what grounds this want of confidence is asserted, we find the old objections answered fifty years ago by Huxley put forward as if they were discovered yesterday. "Darwinism yields no information concerning the causes of variability" (p. 210); "the theory of natural selection is the doctrine of chance"; "the theory of mutation plays with chance even more than selection." What is Darwinism but a method? The author uses this word as if it implied a corpus of knowledge which could not be extended, and was to be judged by its expression in the writings of casual essayists. In only a single place does he refer either to the "Origin" or to "Variation under Domestication," though he quotes extensively from modern critics. It is idle talk to say that Darwin did this, but not that as though one man could do all, or as if Darwin claimed a complete supremacy for his selection hypothesis. Are we to have no confidence in the theory of natural selection because its discoverer was not able to give a complete treatment of variation? One would really conclude from this book that variation was a subject to which Darwin gave no serious consideration. The old goddess "chance" is once more used as a stick to beat the dog "selection" with, and we become rather tired at the iteration of arguments urged and rebutted any time these thirty years. Even the old crude presentation of the Miltonian "creation" is made to stand up in order to receive fresh blows.

The book is sadly in need of competent revision. The number of misprints is really irritating. Amongst the animals of the tropics we are told there is the leopard and the *gepard*, a creature the nature of which is wholly problematical. The choristers at Rome have well developed "mammals" (p. 148); "*Omni* vivum e vivo" (p. 97); "like all other infusorians, no bell-animalcule is able to reproduce by simple fission" (p. 230); the vermiform appendix "has no function whatever, its object being rather apparently to create suffering." On p. 129 Balanoglossus is classed with Vermes, and the larvæ of Crinoids are termed Bipinnaria, whilst on p. 130 the larvæ of starfish are correctly called by that name, but the figure refers to an Auricularia or Holothurian larva. In his condemnation of sexual selection the author entirely overlooks the careful observations by Mr. and Mrs. Peckham on the spiders of the family Attidæ, and as these support the Darwinian position the whole criticism falls to the ground.

Apart from critical matters, the book is full of interest, and its summary of recent work on heredity is but one example of the wide reading and careful exposition which the author exhibits. Read with due caution the book can only do good.

AN AMERICAN COLLOQUIUM.

The New Haven Mathematical Colloquium. By E. H. Moore, E. J. Wilczynski, and Max Mason. Pp. x+222. (New Haven: Yale University Press; Oxford: University Press, 1910.) Price 13s. 6d. net.

IN the autumn of 1906, at the meeting of the American Mathematical Society, three short courses of lectures were delivered to the assembled experts, and are here published for the benefit of the world at large, or at any rate for that of such persons as are interested in the most recent aspects of pure mathematics. The authors assume that their hearers have a good knowledge of analysis, and the reviewer must do the same, in order to keep within due limits.

Prof. Moore's discourse is an introduction to general analysis, which may be described as an essay on the "functional theory" of Fréchet and others. A free use is made of the Peano stenography, and this is one more sign of a fact which some of us will admit with regret, namely, that students of the logical side of mathematics must become proficient in Peanese.

Two important ideas play a leading part in Prof. Moore's discussion. The first is the dominance of one function by another; μ_1 is dominated by μ_2 if, for every argument p, the absolute value of $\mu_2(p)$ is not less than the absolute value of $\mu_1(p)$. The other, which appears to be both new and important, is that of uniform convergence relatively to a function σ. Thus we have a notation

$$\mathrm{Lt}_n\, \mu_n = \mu\ (\mathrm{R}\ ;\ \sigma),$$

meaning that when R is the range of the variable x, and $(\mu_1, \mu_2, \ldots)$ is a sequence of functions of x, this sequence converges in such a way that, by taking n large enough, and for all greater values of n, $|\mu-\mu_n|<e|\sigma(x)|$, where e is any assigned positive number; and if n can be determined by means of e alone (without x), we have uniform convergence relative to σ. When σ is constant, we come back to the usual definition of uniform convergence. The second part of the essay is on composition of classes, which may be described as a generalisation of the theory of the composition of moduli and ideals in the theory of numbers.

In connection with a certain notation, the author remarks that "the intention is to discriminate sharply between function and functional value." With this we confess we are in sympathy, though, of course, we shall be told that a function is merely an enumeration of values, either actually or potentially complete. In the abstract, of course, this is undeniable; but consider the function $\sin x$, for example. Its property of being periodic is intrinsic, and was actually realised before there existed a table of its values, or rather it was made part of a generalised definition of $\sin x$. Again, the class of algebraic numbers, or that of algebraic functions, surely has a significance apart and beyond the aggregate of values associated with it.

The next essay is upon projective differential geometry, especially in connection with ruled surfaces. Various results of great interest and generality are obtained by the author; for instance, it appears that

an arbitrary space curve being given, it can be considered as one branch of the flecnode curve of an infinity of ruled surfaces, into the general expression of which there enters an arbitrary function. On the other hand, two curves taken at random cannot be connected, point to point, so as to be the complete flecnode curve on the ruled surface thus generated. As the author remarks, there is no doubt that the field thus opened promises valuable results. So far as the analysis goes, it follows the lines of the known theory of differential invariants, constructed by Halphen, Lie, and others.

Finally, Prof. Mason gives an interesting summary of various boundary-value problems of differential equations. Perhaps one of the most elegant things in this essay is the construction of a doubly periodic Green's function G, which satisfies the equation $\Delta u=0$ within the period rectangle, except at two points where it is logarithmically discontinuous. This is followed by a remarkable application to the equation $\Delta u=f(x, y)$, where f is periodic in x, y independently, with periods a, b equal to the lengths of the sides of the period rectangle of G.

It is noteworthy to find the United States maintaining so many distinguished mathematicians, both native, and, if we may be excused the term, imported. When will the English nation wake up to the fact that it is not waste of money, or at best a concession to dilettante ideals, to provide a living for a first-rate mathematician, even if he proposes to devote his life to varieties in n dimensions, or the theory of aggregates, or the distribution of primes? Surely, and at an accelerating rate, the dominion over nature and over their fellow-men is coming into the hands of the star-gazers, the speculators, the originals, who have been lampooned and pilloried from the age of Aristophanes to that of Swift, and from his days to our own. Or rather, the material profit, the worldly dominion, will come to those nations that have the sense to see that by attracting these creators of new ideas they are encouraging every kind of higher invention, and buying in the cheapest market the best of goods—brains.

G. B. M.

IMPRESSIONIST ASTRONOMY.

The Night-Skies of a Year: Being the Journal of a Star-gazer. By J. H. Elgie. Pp. xii+247. (London and Leeds: Chorley and Pickersgill, Ltd., 1910.) Price 6*s.* net.

TAKING sections for each month of the year as basis, the varying aspects of the constellations are presented in a series of discursive notes purporting to describe the impressions of the writer on the occasions when he observed the various objects. The author takes as his aim the task of teaching the geography of the sky by means of a journal showing how the constellations alter in their relative aspects from night to night, and at different times on any night. So far this is commendable. It is evident, however, that the desire to produce a volume of impressive magnitude has induced the decision to inflict a superfluity of purely personal impressions; if these were in the main likely to be experienced by other observers, they might be helpful, but from the nature of many of them it is very questionable if they can be. Take as an example the following:—

"Ten o'clock! Ugh! How drear and dismal is the night, a night unrelieved by star or moon. Rain is beginning to fall. The tempting gleam of a brightly burning fire comes out to me through my window, so I will indoors and try to think that this really is the opening of the 'merrie month.' Then, to round off the evening presently, I will study anew an appropriate article on the old, old question of 'Is the climate changing?' If matters do not mend soon I shall alter my opinion on that subject and persist that the climate is changing."

This quotation is a fair sample of the style of the whole, though here and there one finds an oasis of more acceptable material.

The book is illustrated by numerous rough sketches of constellation groups, and if these were not specially intended for instruction they might be passed over. The author specially directs attention to these sketches, and says:—

"I am convinced from the letters of numerous correspondents that the difficulty of recognising the main outlines of the constellations at any hour from the charts accessible to them has damped the enthusiasm of thousands of beginners in the study of astronomy."

Our opinion is, however, that the star alignment diagrams are perhaps the most unsatisfactory feature of the book. Taking any one constellation, even such a well-known one as Orion, for instance, it is shown with the component stars, in different relative grouping on consecutive pages, due, it must be assumed, to defective drawing. We would advise the "numerous correspondents" to purchase a trustworthy star atlas, and endeavour to commandeer the help of a capable friend for about five minutes each week. This would do away with all the damping of their enthusiasm.

SNAKES OF CEYLON.

The Snakes of Ceylon. By A. F. Abercromby. Pp. vi+89. (London: Murray and Co., 180 Brompton Road, S.W., 1910.) Price 2*s.* 6*d.* net.

THE author, being of opinion that the "many works and treatises" in which the snakes of Ceylon are described are "more suited to the scientist than the naturalist," and that "natural history books, on the other hand, seldom give sufficiently detailed information about snakes," has produced a volume which the discerning reader will see at once to be not in the roll of common art. The systematic part being an admitted compilation from well-known works on the fauna of India, we may restrict our inspection to those parts of the book which reveal the originality of the writer.

In dealing with the anatomy and physiology of snakes, the author laments that "the effect of, and antidotes for, snake poison is a subject which has been much written about and much discussed, but very little has been discovered about it." He has heard of permanganate of potash at least, but this, "although a very successful absorbent remedy, is

reported to have a poisonous effect upon the blood." His views on cures for snake-bite are those of a Rip Van Winkle; what we want is—

"not so much a remedy which will absorb and neutralise the poison, as a means by which this neutraliser may be enabled to reach the poison, or a treatment for keeping up the vitality of a patient until the poison becomes absorbed by the system."

In short, he makes the words "absorbed" and "absorbent" as odious as the word "occupy" was to Doll Tearsheet.

In the chapter on "hunting" snakes, our author is as coherent and profound as honest Dogberry himself. The "necessary point" in this hunting to be borne in mind is that "it is less important to go where there are a great many snakes than to go where the nature of the country facilitates seeing and catching of them." So also, "a cobra is best obtained by digging one out of an ant-heap or hole," but "the cobra must have been seen to enter the hole a short time before," for all is vanity. As to smoking a snake out, "it takes a lot of smoke to have any effect on a snake, owing to the latter's lung capacity." The snake has only one lung, but that, like the one eye of Mr. Midshipman Easy's friend, the master's mate, is of prodigious power. When the author tried smoke "it was so suffocating and so blinding that the capture of the snakes was extremely difficult and somewhat risky"; little wonder that he regards it as "an unsatisfactory proceeding." The way to comprehend vagrom pythons "can only be learnt by practice"; but if the python be asleep "it can often be captured without any trouble."

Touchstone and his shepherd could not improve the chapter on snakes in captivity.

"When feeding a tame python great care has to be exercised lest the snake should seize your hand in mistake for a rat, especially if your hand has just been in contact with the latter."

Truly it requires the careful experiments of a natural philosopher to discover

"that cold is not so injurious to these reptiles as is commonly believed, but that it is the infrequency of the sun's rays that renders a climate such as that of England unsuitable for serpents."

Finally, we would commend this weighty precept:

"Those who are desirous of keeping a serpentarium of live snakes should study as much as possible the conditions under which the various snakes live when in the wild state,"

otherwise they labour in vain on their "serpentarium."

THE METHODS OF ANTHROPOLOGY.

The Racial Anatomy of the Philippine Islanders. Introducing New Methods of Anthropology. By Prof. R. B. Bean. Pp. 236+25 photographs. (Philadelphia and London: J. B. Lippincott Company, 1910.)

THE most recent literature dealing with the study of man's physical characters reveals manifold signs of a widespread revolt against the domination of mere anthropometry in this field of research. It is often urged that no kind of investigation can claim the title "exact," or even be called "science," unless it deals with evidence that can be expressed in figures or mathematical symbols. But in all biological inquiries a primary sorting of the material is an indispensable preliminary to its mathematical treatment, and until the obviously heterogeneous elements in any series have been sifted, one species of material being separated from another, and males distinguished from females, any attempt to deal statistically with measurements of such unsorted material can produce only confusing and misleading conclusions.

The most urgent need in anthropology at the present time is the determination of those characters of the human body and its parts, which have definite significance as indications of race, and the investigation of the exact value and meaning of such traits, and of the bond of union between them and other distinctive characters, which are associated in groups in different individuals.

The comparative sterility of recent work in anthropology, so far as the determination of racial characters in series of skeletons is concerned, is due mainly to the common neglect of such preliminary studies and the immediate resort to blindly-made measurements as the sole means of investigation. It is the great merit of Sergi's work that he insisted on this return to the ordinary methods of zoological investigation in dealing with human remains, and by the use of such methods, crude and unsatisfactory as some of them undoubtedly are, he has been able to recover a great deal of true history of man's movements, and information concerning his affinities.

Prof. Bean's interesting book on the people of the Philippine Islands claims the consideration of the anthropologist, not so much for what he has accomplished, as from the fact that it is an attempt to direct the investigation of racial anatomy into its proper channel, for in it he has attempted to discriminate between the peculiarities of conformation of the external ear in the different racial elements in the Philippines, and use them as indices of race in precisely the same manner as the zoologist or "the man in the street" would distinguish a cat from a dog, even if these animals were of precisely the same size and quite irrespective of the measurements of their crania or other bones.

Dr. Bean has correlated the various types of ear with a large series of other physical characters, as well as with stature, proportion of limbs and trunk and head; and, like others who have undertaken similar investigations upon man or other living creatures, he finds that "the method of grouping reveals types that apparently represent *character-complexes* composed of unit characters," which "hang together in heredity or break up when crossed with other *character-complexes*."

Throughout the book the author is ever on the alert to detect Mendelian phenomena, and in chapter x. he builds up a scheme for the explanation of heredity in human mixtures.

The most unfortunate feature of Dr. Bean's sug-

gestive essay is his application to the peoples of this far-eastern island of terms such as "Alpine," "Adriatic," "Iberian," "Cro-Magnon," and others, which are not without objections even when applied to the population of Europe, but become doubly misleading when applied to Filipinos, who are partially hybridised with real Iberians.

G. ELLIOT SMITH.

PROF. GROTH'S CHEMICAL CRYSTALLOGRAPHY.

Chemische Krystallographie. By P. Groth. Dritter Teil, Aliphatische und hydroaromatische Kohlenstoffverbindungen. Pp. iv+804. (Leipzig: W. Engelmann, 1910.)

DESPITE the duties appertaining to a professorial chair and the unremitting labour attaching to the editorship of his flourishing *Zeitschrift für Krystallographie und Mineralogie,* Prof. von Groth proceeds steadily and rapidly to the completion of the great task he has set before him. The successive volumes have appeared at intervals of two years, and now, four years since the publication of the first, we welcome the issue of the third and penultimate volume. It includes the various aliphatic and aromatic compounds that have been obtained in crystallised form, and meets a widely and long-felt want. Putting aside a few oxalates which occur in nature, it has hitherto been impossible to turn up readily the crystal character of any of these substances; even the most comprehensive text-books on organic chemistry rarely define the forms more exactly than as being plates or needles.

The volume is composed of two parts, of which the first is by far the longer. In it the paraffins and the corresponding olefines are grouped together according to the number of carbon atoms in the molecule, the concluding chapter being devoted to the ureas and the derivatives of uric acid. In the second part the hydrobenzol derivatives and the terpenes and camphors are considered. For each substance the physical characters are stated tersely, but as completely as possible, the information including the melting point, the specific gravity, the morphological characters—the axial ratios, the indices of the observed forms, the values of the principal interfacial angles, and the directions of cleavage, if any, illustrations of crystals possessing features of exceptional interest being given—and the optical characters—the principal refractive indices for light of various standard wavelengths, the nature of the refraction, the relation of the optical indicatrix to the crystalline symmetry, and the optic axial angle; the authority for the data is recorded, and references to the original papers are given in footnotes. Each section is prefaced by a brief but interesting discussion of the substances dealt with and the relations subsisting between them. The book closes with two complete indices; in one the substances are arranged alphabetically by their names, and in the other by their formulæ in ascending order of the number of carbon atoms in the molecule. Little difficulty should therefore be experienced in tracing any particular compound. It is abundantly clear that every effort has been made to keep the book as free from errors as possible; in a work of this kind accuracy is everything.

The name of the publisher is sufficient guarantee for the excellence of the printing, which is, in fact, beyond criticism.

APPLICATIONS OF PHYSICAL CHEMISTRY.

(1) *Themen der physikalischen Chemie.* By Prof. E. Baur. Pp. iv+113. (Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1910.) Price 4 marks.

(2) *Das chemische Gleichgewicht auf Grand mechanischer Vorstellungen.* By Prof. H. v. Jüptner. Pp. v+367. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE two volumes here noticed are not text-books of physical chemistry in the ordinary sense. They deal with selected parts of the subject, and are distinguished by the prominence given to its technical application.

Prof. Baur's book contains the substance of a series of vacation lectures delivered in the Brunswick Polytechnicum at the instance of the Society of German Engineers. The lectures are models of clear exposition, and are invariably terse and to the point. The experimental illustrations, directions for the repetition of which are included in the text, are well chosen, and calculated to stimulate inquiry. After a preliminary lecture on the principles of modern physical chemistry, the author proceeds to discuss such varied matters as voltaic cells, the blast-furnace, Deacon's process, the contact process for sulphuric acid, the production of atmospheric nitrate, catalysis, gas explosions, explosives in general, metallography, and colloidal chemistry. Students, both of industrial and of pure chemistry will find much to interest them in the little volume.

Prof. von Jüptner's work on chemical equilibrium is based on the following conceptions. The maximum external work which a chemical process is capable of performing is a measure of the chemical affinity of the process. This work can be measured by the gas pressures of the substances concerned. Hence chemical processes may be treated as mechanical, one substance being pumped into another (production of a compound) or being pumped out of another (decomposition of a compound). Thus dissociation phenomena may be considered as being at the root of all chemical processes. If the dissociation-pressure curves of all compounds are known, the behaviour of the compounds when they are brought together may be predicted; those with greater dissociation pressures will be decomposed, those with smaller dissociation pressures will be formed. The process will come to an end when the partial dissociation pressures of the common product (*e.g.* oxygen pressures of oxides) become equal.

Proceeding on these principles, the author considers the equilibrium conditions in systems with solid, liquid, and gaseous phases. As the book is intended in the first instance for practical men engaged in chemical industry, it is characterised by a wealth of

numerical data for dissociation pressures. The equations employed are often only approximate, but though subject to future correction, they cannot fail to be useful. In the study of iron and steel the author has achieved special eminence, so that the last chapter, which is devoted to the application of the above principles to the chemical reactions occurring in the blast furnace will be read with peculiar interest.

OUR BOOK SHELF.

The World of Dreams. By Havelock Ellis. Pp. xii+288. (London: Constable and Co., Ltd., 1911.) 7*s.* 6*d.* net.

MR. ELLIS very truly remarks that in the past the literature of dreaming has often been vitiated by bad observation and reckless theory. In the volume under review he gives a large number of carefully recorded dreams—chiefly his own—and is sparing of hypothesis. The drift of the book may be indicated as follows:—

The sleeping consciousness is weak in apperception and in will. It is, in fact, partly dissociated, as in insanity. But it can *reason;* and dreams are its serious and careful attempts to construct an adequate theory of the phenomena. These latter psychical facts may be sensations derived from external stimuli such as sounds—as when the drip of water from a burst pipe upon the floor near a dog's bed caused his owner to dream that the dog was being crushed in a mangle—or from visceral disturbances, as when indigestion causes dreams of terrifying situations. Stimuli of any kind are magnified by the sleeping consciousness, and the theory (the dream) is consequently out of proportion to their real importance, as when the singing of a canary caused a dream of the performance of Haydn's "Creation." Fear-dreams are often exaggerations of dimly-realised bodily discomfort, as when a lady had a horrible dream of murder after a supper of pheasant. The interesting point about this is that the dream is the result, and not the cause, of the emotion. Unpleasant feelings are really experienced, and the dream-consciousness invents a theory to account for them. This is in line with the James-Lange theory of emotion in general.

As to ultimate psychical origins, Mr. Ellis thinks that Freud presses his sexual-wish theory too far. The great Vienna psychologist has done brilliant work, but has become obsessed by his pet formula. His key will not fit all the locks. Probably most psychologists will now agree with Mr. Ellis on this point.

The chapter on dreams of flying and falling is particularly good. It can scarcely be doubted that the absence of pressure against the soles of the feet—a vague mass of sensation always present when standing or sitting—must have a great deal to do with these dreams. The other sensory nerves over the body being relaxed and inactive, the bed ceases to be felt; and the consequence is a dream of floating unsupported in the air. This suggests an explanation of the subjective feeling of levitation in the case of many saints. In ecstasy there is considerable anæsthesia, both of the soles of the feet and elsewhere.

The book is popular in style, but is thoroughly scientific in method, and Mr. Ellis has a wide acquaintance with the work of other investigators in this field. His contribution is a welcome one.

The Economy of Food: a Popular Treatise on Nutrition, Food, and Diet. By J. Alan Murray. Pp. xii+253. (London: Constable and Co., Ltd., 1911.) 3*s.* 6*d.* net.

THE subtitle of Mr. Alan Murray's book and the following extract from the preface will indicate its scope:—"The book is intended for students of domestic economy, cooks, caterers, housekeepers, and managers of institutions rather than for specialists in physiology, chemistry, and hygiene. The subject cannot be treated adequately without reference to the principles of these sciences; but the more difficult parts have been relegated to footnotes, and the use of technical terms in the text have been avoided as far as possible. The first section deals with the requirements of the body. The origin, properties, and composition of the commoner kinds of food are discussed in the second. In the third an attempt is made to combine these two branches in a form suitable for everyday use—to translate protein, carbohydrates, &c., into terms of bread and meat, *i.e.* of breakfast, dinner, and supper."

Mr. Murray has been very successful in his attempt; the scientific portions are accurate and up-to-date, the practical parts will fill a long-felt want, and the whole is presented in a clear and readable manner. In these days when so much rubbish is printed for popular consumption in the daily Press and elsewhere on the subject of food and diet, it is a godsend to have a really trustworthy and popular guide which it is a real pleasure to be able to recommend. Food, of all other subjects, is one which lends itself to the exploitation of fads. There is nothing of the sort in the present volume; we have no advocacy of any particular system, no hysterics on the subject of the Chittenden diet, or sour milk, or standard bread, but just plain, simple, sober, common sense. W. D. H.

A Text-Book of Botany. By J. M. Lowson. Seventh impression (fifth edition), revised and enlarged. Pp. viii+607. (London: W. B. Clive, University Tutorial Press, Ltd.; Cambridge: University Tutorial Press, 1910.) Price 6*s.* 6*d.*

ALTHOUGH there have been numerous and material alterations of the subject-matter for this edition, there is no change in the general arrangement, and the book still maintains its very apparent examination character—that is to say, the dominating idea is not to stimulate the observational and thinking faculties but to provide in the space as much information as possible, duly punctuated and diagrammatised. The general arrangement is not unsatisfactory, but it is not apparent why there should be such an early insertion of a chapter and various sections dealing with histology; also it may be suggested that the heading of chapter iv. would nowadays be more applicable to the chapter on ecology. The latter is a new introduction and requires revision, as the exposition is disjointed, and there is no mention of that important unit of classification, the formation. For the most part, however, the presentment of the information is essentially explicit and well ordered, and the trend of recent investigation and modern theories is carefully indicated. A useful series of physiological experiments is outlined, and the importance of combining practical work with reading is emphasised. The selection of cryptogamic types and the general scope of the book follow the requirements of the intermediate examinations at London University.

Le Chaos et l'Harmonie universelle. By Félix le Dantec. Pp. 195. (Paris: Félix Alcan, 1911.) Price 2.50 francs.

To a long list of previously published works, M. le Dantec has added a book dealing with a variety of subjects treated sometimes from a philosophical point of view, and at others from the mathematical side. To give the titles of a few of the sections is to indicate the range of the treatise. "Heredity and education," "the definition of chance," "living bodies," and "life," may be mentioned.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Breath Figures.

On reading Lord Rayleigh's short article on breath figures in NATURE of May 25 and finding he was not satisfied with the explanation I offered of them, I thought it would be as well to see if it was possible to get some further information on the subject. For this purpose I repeated the experiments with variations in the conditions. As the writer of the article seemed to think that the hot gases act in some way in cleaning the surface of the plate, the experiments were now made at lower temperatures. In place of the blow-pipe flame a Bunsen burner was used, and in order to protect part of the surface from the action of the hot gases, the plate was supported on two thick iron bars, so as to confine the action of the gases to the narrow space between them, and further, the glass plate was kept as cold as possible. It was intended to use ice for this purpose, but it was found that it kept the under surface always dewed, so that the gases could not come into contact with the plate. Wet blotting-paper placed on the upper surface was found to keep the plate cool enough, and yet not so cold as to cause the deposition of dew. It was found that it was not necessary to pass the plate through the flame to get the breath figures; it could be held some distance above it with a similar result, but, as might be expected, a longer time was necessary than when in the flame, not only on account of the lower temperature of the gases, but also on account of the plate getting heated by the longer exposure.

In these experiments it was noticed that it is not enough to allow the hot gases to travel along the space between the two bars, as the hot gases only produce the effect where they first strike the surface of the plate, and if it is dust that is the cause of the action, it will be deposited where the gases first touch the cold surface, the onward flowing gases near the plate being nearly free from dust, as well as being at a lower temperature. The plate should therefore be moved over the stream of hot gases in such a way that fresh gases come in contact with the different parts of the exposed surface. The plate should also be held at a considerable angle to allow of a free flow of the gases over it.

If the action of the hot gases is a cleansing one, then heat alone ought to produce the same effect as the flame, and cause the glass to take an even film of dew. To test this a cleaned plate was placed—clean side up—on a metal plate somewhat larger than itself, and the metal plate highly heated with a Bunsen burner. Some plates were heated slightly, others to a temperature far higher than those acted on directly by the flame, yet when cold these plates were unchanged. Part of the plate was freshly cleaned, when it was found that the deposit of moisture was the same all over the plate. Heat alone evidently has no effect. I may here mention that those breath figures are best developed by rubbing the back of the plate with a piece of ice. By this process the image remains longer in view, and gives time for inspection.

An examination, by means of a short-focussed lens and proper illumination, of the moisture condensed on the surface of a glass plate, reveals some interesting points. When the dew first begins to appear the water is seen to be deposited in the form of very small lenses nearly touching each other. On looking through the plate while the dew is still condensing, nothing can be seen through it. It acts very much like a piece of ordinary ground glass, a landscape being invisible; even the sky-line does not show. If the cooling be now stopped and the deposit allowed to evaporate it will be noticed that the spaces between the lenses widen, the lenses drawing in their edges and leaving clear glass. Objects can now be seen through the plate, the transparency increasing as the dew evaporates. If, however, in place of stopping the condensation at its early stages we keep the plate cooled so as to cause more moisture to be deposited, the lenses will be seen to grow into each other and coalesce, until at last the regular deposit of little lenses grows into irregularly shaped blotches of water of considerable size. If the condensation be stopped at this stage and the plate dried and again cooled, it will be found that the appearance of the condensation is not the same as it was the first time. The surface of the plate has been changed by the first condensation. On the dew making its appearance the second time the uniformity in the lenses is gone. In addition to a general ground of small lenses there now appears a number of much larger ones, and as these are distributed over the plate at about the same distance from each other as that occupied by the large evaporated blotches of water, they would appear to be produced by something left by the water on the glass. By observing a particular group of blotches near a mark on the plate, it was noted that each one of these reappeared on each successive dewing. The something which is left after evaporation has evidently a considerable affinity for water, as these large lenses condense more water than an equal area of small ones. They stand high, and are the last to evaporate.

But perhaps it will be asked, How can anything be left after the evaporation of pure distilled water? At first sight one might feel inclined to say that nothing could be left. It is, however, evident that something has been left—probably dust and gaseous impurities condensed along with the water—and I may point out that something similar happens when cloud particles of water are formed on ions in the presence of certain gases. In this case there are no solid nuclei, yet the drops do not thoroughly evaporate, but leave behind them something large enough to be nuclei of condensation in air only very slightly above saturation. These observations on the behaviour of glass plates show how delicate their surfaces are and how easily the condensation on them may be altered.

The something which produces these breath figures formed by flames is of such a nature that it acts more powerfully the higher the temperature of the gases, that is, the greater the difference in temperature is between the gases and the glass. Of course, it is possible that the effect may be due to some gas or gases condensed on the glass, and these gases having an affinity for water. On the other hand, it may be due to the gases depositing their fine dust; and while what we call clean glass repels water, dust, on the contrary, attracts it. The fact that this form of breath figure is easily washed off the plate seems to point rather to dust than absorbed gases as the cause.

The formation of these breath figures does not appear to be so much a question of cleanliness as of the nature of the foreign matter on the surface of the glass. If the impurity is of a water-repelling nature we get the lenticular deposit; if it has an affinity for water we get the uniform film. For instance, if the plate has been previously touched with paraffin oil, it will, even after a good deal of cleaning, give a very white obscure deposit, due to the great convexity of the lenses. On the other hand, if the surface has been previously treated with caustic soda, the lenses are flat and the plate more transparent.

As these experiments have generally been made with gas flames, and as the flame is an important factor, it was thought advisable to try other flames. Hydrogen when burned in filtered air, I have shown, gives rise to no fine dust, and, so far as I know, this is the only form of combustion which does not. It therefore ought to have been tested, but as the apparatus required would be somewhat complicated, it has not been done. Alcohol, however, was tried; with it I could only succeed in getting very slight indications of any action, though the plate was heated far more by it than what gave a marked effect with the Bunsen flame. This result is what we might expect if the figures are due to dust. A sulphur flame was also tried, and, as might be expected, gave very marked results with a very small flame. This might be given as a typical case of the effect of condensed vapour. Something of this kind may play a small part in the figures produced by gas flames.

It was thought it might be interesting to see how the fine dust on our windows acted towards condensed water. The fine dust in the air is deposited on our windows in the

same way as I imagine the dust of the flame to be deposited on the plates, namely, by difference of temperature, our rooms being warm and windows cold at night. The only difference is in the rate of deposit, due to there being less dust in the room air and to the smaller difference in temperature in the case of the window. Cleaning a small part of a window which had been clean ten days previously, a piece of ice was rubbed over the outer surface until dew began to deposit on the inside. The deposit on the ten-day-old surface was different from the newly cleaned one, but not greatly so. While the newly cleaned part was covered with the usual little lens-like discs, the older surface was covered with much larger and irregularly shaped blotches of film. As the nights had not been cold since the window was cleaned, we can hardly expect much dust to have collected in ten days; so another window was tried which had not been cleaned for some months. Repeating the cleaning and cooling on this window, it was found that while the newly cleaned part carried a ground-glass-like deposit, the uncleaned part was sufficiently clear for the landscape to be seen through it. These tests show that dust on glass does tend to cause water condensed on its surface to spread and take the film form in the same way as glass that has been exposed to flame or to hot gases.

Coming, now, to Quincke's experiment, referred to by Lord Rayleigh, in which sulphuric acid is shown to produce the same effect as the blow-pipe flame, this and the experiment with hydrofluoric acid seem to have inclined Lord Rayleigh to think that cleanliness was the cause of the breath figures. But does either sulphuric acid or hydrofluoric acid prove cleanliness? I have doubts. I know I am on dangerous ground in differing from Lord Rayleigh on anything connected with surface action, yet I have recently had my lesson on how some substances cling to glass in spite of efforts to get rid of them, and I think it is not improbable that some residual of both sulphuric and hydrofluoric acid may cling to the glass in spite of washing. Recently I was making an investigation in which was required a little iodine vapour, and for this purpose put a small crystal of iodine in a flask from which the vapour was drawn as required. Afterwards the investigation took another turn, and the flask was used for other purposes, but many days' work were lost owing to that flask. Results were obtained with it which were contrary to previous experience. As suspicion centred on the flask it was discarded, and not until a new flask had replaced it could satisfactory work be done. Yet all this loss of time was occasioned by a residual quantity of iodine, which the washings with alcohol, acids, soap water and a sponge, had not succeeded in removing. After that experience I confess to being sceptical of absolute cleanliness of glass after being touched with sulphuric or hydrofluoric acid. Any residual of these substances, as they have an affinity for water, would tend to form films and not little lens-like patches. Though breath figures may be formed by dust, yet there are evidently other ways of altering the surface of the glass and causing it to repel or attract water, and so making the surface capable of giving breath figures. John Aitken.

Ardenlea, Falkirk, June 5.

The "Vernal Phytoplankton Maximum."

In Nature for April 27 it was stated, in connection with the plankton statistics taken periodically in the Irish Sea from the Port Erin Biological Station, that (p. 289) "the outstanding fact in this season's work, so far, is that the diatoms are unusually scarce and late. The vernal phytoplankton maximum has not yet arrived."

That statement referred to the collections up to the middle of April. During the rest of April the catches remained small—for the most part 1, 2, or 3 cubic centimetres in a standard haul of the fine silk net. In May the approximate quantities (they have not yet been accurately measured), in the same net, run as follows:—

	c.c.		c.c.
May 1	2	May 22	35
,, 4	1	,, 25	10
,, 10	10	,, 29	15
,, 13	40	June 1	15
,, 16	60	,, 3	60
,, 19	50	,, 5	50

The large catches on May 13–22 were mainly composed of Chætoceras (*C. debile*, and a few other species of diatoms), while the sudden increase in the beginning of June is due almost wholly to Rhizosolenia (mainly *R. semispina*).

Last year we found that the vernal phytoplankton appeared as two well-marked maxima, one in April, caused by species of Chætoceras and Lauderia, and a second in June, composed of Rhizosolenia and Guinardia.

It is evident that the "vernal maximum" is really a complex made up of the maxima of several different species or groups of species which seem to occur in a definite sequence, but may be earlier or later, more spread out in one year or more telescoped together to form a single diatom maximum in another. Moreover, the individual species or groups of species may be more abundant one year than another.

In the present year, if we look at the three genera that usually bulk largest in our spring and early summer collections, we find that Biddulphia reached its climax in March (but continued throughout most of April in fair abundance), Chætoceras not until the latter part of May, and Rhizosolenia in early June. Rhizosolenia is usually as late as or later than this; Biddulphia is always one of the first forms to appear, sometimes causing a slight increase in the plankton as early as February, so it is really Chætoceras (some of the species of which are usually the most abundant of our April diatoms) that is this year unusually late.

I have just returned from Port Erin, where, during the first few days of this month, Rhizosolenia seemed to be unusually abundant. The water of the bay is visibly discoloured by it; when a tow-net at the end of a fifteen minutes' haul is raised from the sea it contains a column of thick soupy fluid, which runs out very slowly, as the meshes of the silk are largely clogged up with the diatoms; on a calm surface, with the sun shining, the peculiar iridescent glistening appearance characteristic of Rhizosolenia can be seen from the boat, and anything put into the water is at once covered by a slimy layer of the slender needles. It may be that Rhizosolenia has not even yet attained its climax, but a week ago the June increase in diatoms had certainly set in with unusual force. The "vernal maximum" has, then, this year been spread out and divided into three parts—a slighter increase in March (Biddulphia), a much greater one, later than usual, in May (Chætoceras), and another great increase (Rhizosolenia) early in June. W. A. Herdman.

Liverpool, June 10.

On the Action of the Latex of *Euphorbia peplus* on a Photographic Plate.

In August, 1909, our attention was directed to certain properties of surgical importance possessed by the milky juice of *Euphorbia peplus*, a spurge naturalised in this colony. During the examination of the milky juice or latex, we exposed during two days in the dark a highly sensitive photographic plate some millimetres above a sheet of glass on which we had dried a few drops of the juice. On development, a sharp image of the dried juice appeared on the plate. We propose to describe briefly a few results from the many experiments since made to determine the conditions and nature of the action on the photographic plate.

Thirty drops of the juice were spread on a sheet of glass as the letters EUPHORBIA, and the glass dried in an oven at 100° C. for two hours. A sharply defined image of the letters was produced on development of a photographic plate (speed 325) placed 5 mm. above the dried juice after an exposure of forty-eight hours or longer. The density of the images increased with greater length of exposure, with thicker films of dried juice, and with less distance between the plate and the film. The edges of the images were well defined, as if focussed on the photographic plate. No image appeared with short exposures of twenty-four to forty-eight hours unless the films were very thick. With long exposures, up to thirty days, the images were more dense, but showed a little diffusion at the edges of the letters. When a distance of 15 mm. separated the photographic plate from the film, the plate was unaffected. Action on the plate diminished

rapidly when the distance from the film exceeded 5 mm. The dried juice retained the action with undiminished effect for months. When the dried films were heated from 150° C. to 200° C. they charred, but did not lose their action on the plate. As the temperature was raised further the power of affecting the plates was diminished, as the ash of the juice became white. Even the white ash had a slight action on the plate (potassium salts).

The introduction of screens between the film and the photographic plate led to notable results. The interposition of tissue paper slightly delayed the action on the photographic plate. Thick black paper (0·13 mm.) employed by the makers to enclose photographic plates, and found by us impenetrable to the rays from phosphorescent salts, served only to delay the time in which an image of a definite intensity was formed. The effect was produced through a celluloid screen (0·07 mm.) and through paraffined paper (0·03 mm.). We were unable to obtain screens of glass or mica less than 0·02 mm. in thickness. These screens completely protected the plates from action by the film. Screens of aluminium foil 0·002 mm. thick made no alteration in the intensity of the image of the film. When eight layers of the aluminium foil were superimposed, the density of the image on the plate was increased.

Examination of the dried material with a zinc sulphide screen failed to show any scintillations due to the α particles.

When a rapid current of dried air was passed obliquely between the plate and the film at a rate of 300 c.c. per minute the image of the letters on the film was sharp and well defined. The distance between the plate and the film was 0·5 mm. Any gas or emanation would have been carried along by the current, especially any gas having such a slow action on a photographic plate.

H. G. Chapman.
University of Sydney, May 3. J. M. Petrie.

Musical Sands of Eigg.

Since Hugh Miller's brief reference ("The Cruise of the *Betsey*") to the musical sands of the Bay of Laig, Isle of Eigg, much has been done with these, and sands of a similar character, to enable us to account for the cause of the phenomenon; and the interest taken by physicists in certain experiments which I conducted some years ago induces me to offer the results of some further observations for publication.

There is no musical sand in the Bay of Laig, and, so far as I can ascertain, its sands have never been musical within the memory of any inhabitant of the island. At the present time the psammological conditions are such as to preclude entirely the possibility of its existence there.

In a small bay—about a mile and a half along the shore to the north of Laig Bay—known as Camas Sgiotaig, musical sands occur. This bay is divided into two portions by a reef of calcareous sandstone jutting out from the cliffs seawards. In both portions, but especially close to the cliffs, a white quartzose sand has accumulated, and this is the only place where musical sands are found in Eigg.

The sands are derived from the waste of the calcareous sandstone referred to. In places the grains have accumulated in small rifts and cavities in the rocks, and in all such it was found to be equally musical, showing that long, flat stretches of sand are not essential conditions for the selective action of the winds and sea-waves.

The usual experiments with various vessels and plungers, &c., were carried out *in situ*, and the musical effects were in all cases much more pronounced than those produced by the Studland Bay sand.

An extraordinary volume of sound was obtained by dragging the convex part of a wooden bowl along the surface of the sand patches, one of which was only about 6 feet square. When the same bowl was partially filled, and the sand struck with a wooden plunger, it emitted a noise like the deep bark of a dog, and this could be heard for a considerable distance along the shore.

These musical sands are only found in calm weather; in the winter the huge waves carry away all fine matter, and only the rocks remain—for which reason we must regard it as a fine-weather phenomenon in this island.

Eigg, June 6. Cecil Carus-Wilson.

P.S.—Since the posting of my letter respecting the musical sands of Eigg, I have read the letter from Mr. Thomas which appeared in Nature of June 8.

Prof. Poynting, I think, informed me of the occurrence of these sands at Barmouth some time ago, and I have found them also at Penally, near Tenby, at Longland Bay, and in Swansea Bay.

I have frequently pointed out that the pitch of the note emitted from musical sands depends (*a*) upon the size of the grain, (*b*) the area of the plunger's striking surface, and (*c*) the form and composition of the vessel used. In some vessels of particular form I have succeeded in producing from the same mass of sand, and during the one thrust of the plunger, notes of both high and low pitch!

The vessel containing the sand is first well shaken in order that the smaller grains may settle at the bottom of the mass and the larger ones at the top. The plunger is then thrust sharply upon the surface, and coming first in contact with the larger grains, it produces a low note; this merges into a note of higher pitch as the plunger penetrates the mass and reaches the finer grains at the bottom of the vessel.

As a matter of fact, the notes from all natural musical sands appear to be a cumulative effect due to a combination of high and low pitch within a given range. The only sand which seems to emit a pure and definite note is that which I have produced artificially.

June 10. C. C.-W.

Botanical Research in Ceylon.

The letter from Cambridge with the above title, which appeared in your issue of May 25, has evidently been written without knowledge of the difficulties which have arisen at Peradeniya within the last few years and under a complete misapprehension of my views.

The letter reproduces, without the context, a single sentence from a memorandum of mine. In this memorandum special stress is laid on the importance of maintaining Peradeniya as a centre of botanical research, and it is suggested that Dr. Willis should remain as its director under such conditions as would allow of his conducting botanical investigations which in recent years he has found it impossible to undertake.

The letter seeks chiefly to justify Dr. Willis's position as a botanist, which has not been called in question. Neither have the services which Peradeniya has rendered to the botanical workers who have visited it been questioned.

The sentence quoted from my memorandum refers to the two principal members of the staff and the difficulties which admittedly have rendered botanical research impossible for them owing to the pressure of other work.

My suggestion, as a solution of the difficulties which have arisen, was to maintain Peradeniya "as a great reference garden and centre for botanical research in the tropics"—to reproduce my own words—distinct from, though cooperating with, the Agricultural Department which the Government of Ceylon, most wisely, now desires to establish. Whilst I should have preferred this solution, I am satisfied that the decision to incorporate the Royal Botanic Gardens at Peradeniya with the Agricultural Department will secure what the colony chiefly needs in the interests of tropical agriculture, for the advancement of which the whole community, European and native, is so deeply concerned.

Wyndham R. Dunstan.
June 3.

The Extinction of the Egret.

It will be remembered by those who are interested in the protection of the white heron that the feather dealers have urged that the breeding haunts, or garzeros, of these birds are guarded, and that the moulted feathers are picked up from the ground. From information which has been sent to me from the National Association of Audubon Societies, based on the sworn testimony of a man who

has been personally engaged in feather collecting in Venezuela, it appears that while a few moulted feathers, worth possibly a fifth of the value of those taken from living birds, are collected, there is not the slightest foundation for the statement that the breeding places are protected for the purpose.

Mr. A. H. Meyer, who has come forward, adds the following to his account:—"The natives of the country, who do virtually all the hunting for feathers, are not provident in their nature, and their practices are of a most cruel and brutal nature. I have seen them frequently pull the plumes from wounded birds, leaving the crippled birds to die of starvation, unable to respond to the cries of their young which were calling for food in the nests above. I have known these people to tie and prop up wounded egrets on the marsh, where they would attract the attention of other birds flying by. These decoys they keep in this position until they die of their wounds or from the attacks of insects. I have seen the terrible red ants of that country actually eating out the eyes of these wounded, helpless birds that were tied up by the plume hunters."

The story that the aigrettes used in the feather trade are picked up on the ground in Venezuela is stated by those interested to have been based on a letter written by Mayeul Grisol, naturalist and explorer of the Honorary Mission of the Museum of Natural History of Paris. Prof. Osborn, president of the American Museum of Natural History, recently sent the following cablegram to the Museum of Natural History of Paris:—

"Is Mayeul Grisol of scientific standing? Has he been an accredited explorer for your museum to South America?"

This is the answer:—"Mayeul Grisol unknown."

WILFRED MARK WEBB.

42 Bloomsbury Square, W.C.

THE NATIONAL EXPERIMENTAL TANK.

TO the present-day shipbuilder or shipowner there are probably no more important problems than those of getting the best or least wasteful form of hull with the limitations of dimensions imposed by its service or internal arrangements, and of obtaining a trustworthy forecast of the power required to propel a ship of that form at a given speed.

It is the exhaustive investigations of such problems as these which constitutes the primary object of an experiment tank. Such a tank is to the naval architect what the research laboratory is to the chemist, or the testing house to the engineer. Forty years ago model experiments were looked upon as "remote from practical use," and it was largely due to the fertile brain and the carefully conducted epoch-making experiments of the late Dr. William Froude that this impression has been removed, and replaced by a continually growing confidence in the application of the results of experiments with models to the full-sized ship.

FIG. 1.—National Physical Laboratory Experimental Tank. View looking North (empty).

Many early investigators, amongst whom may be numbered Bernouilli and Euler, attempted to solve the problem of least resistance mathematically.

Later on, in 1770, experiments on a small scale were made by D'Alembert, Abbé Bossut, and Condorcet, and an attempt was made to frame *formula* for forms of least resistance. These were followed by M. Romme, and later by Marc Beaufoy, who for five years (1793 to 1798) made experiments with various models in the Greenland Dock. Unfortunately, owing

to lack of financial support, Beaufoy's experiments were never extended to ship-shape forms, and although he insisted that such experiments would and did determine the relative merits of models, his results were neglected by the naval architects of his time, and only fitful attempts were made to revive interest in model experiments until the time of Froude and Rankine.

Rankine in 1862 read his paper on waves, &c., and in this and various papers published during succeeding years he developed the application of what is now known as the "stream-line theory" to all moving bodies.

Froude at this time, working on much the same lines, had produced his well-known "law of corresponding speeds"[1]—the true connecting link between ship and models—and had verified it by experiments on the river Dart with similar models varying in length from three to twelve feet; and in his "explanations" in the British Association Report of 1869 he insists on the trustworthiness of experiments with models of rational size. At the suggestion of Mr. E. Reed (afterwards Sir Edward Reed), a proposal and estimate was made for an experiment tank, and this was soon afterwards built at Torquay, and became the pattern on which all other tanks were modelled.

Shortly after this, in 1871, on the recommendation of the "Committee on Designs for Ships for War," Froude conducted for the Admiralty the towing experiments on the *Greyhound*, which, in conjunction with the experiments made on a small model one-sixteenth the dimensions of the ship, completely vindicated his theory, and led the Government to establish the experiment tank at Haslar, which was completed in 1879, where his son, R. E. Froude, has since superintended the work. The applicability of results of model experiments to full-sized ships has more recently been verified by some experiments conducted by Mr. Yarrow on a torpedo-boat, and published in 1883.

Such tanks are now possessed by every nation that has any pretence to marine power, and by several of our leading shipbuilding firms, and the national experiment tank, which is now approaching completion at Teddington, is the sixteenth to be built.

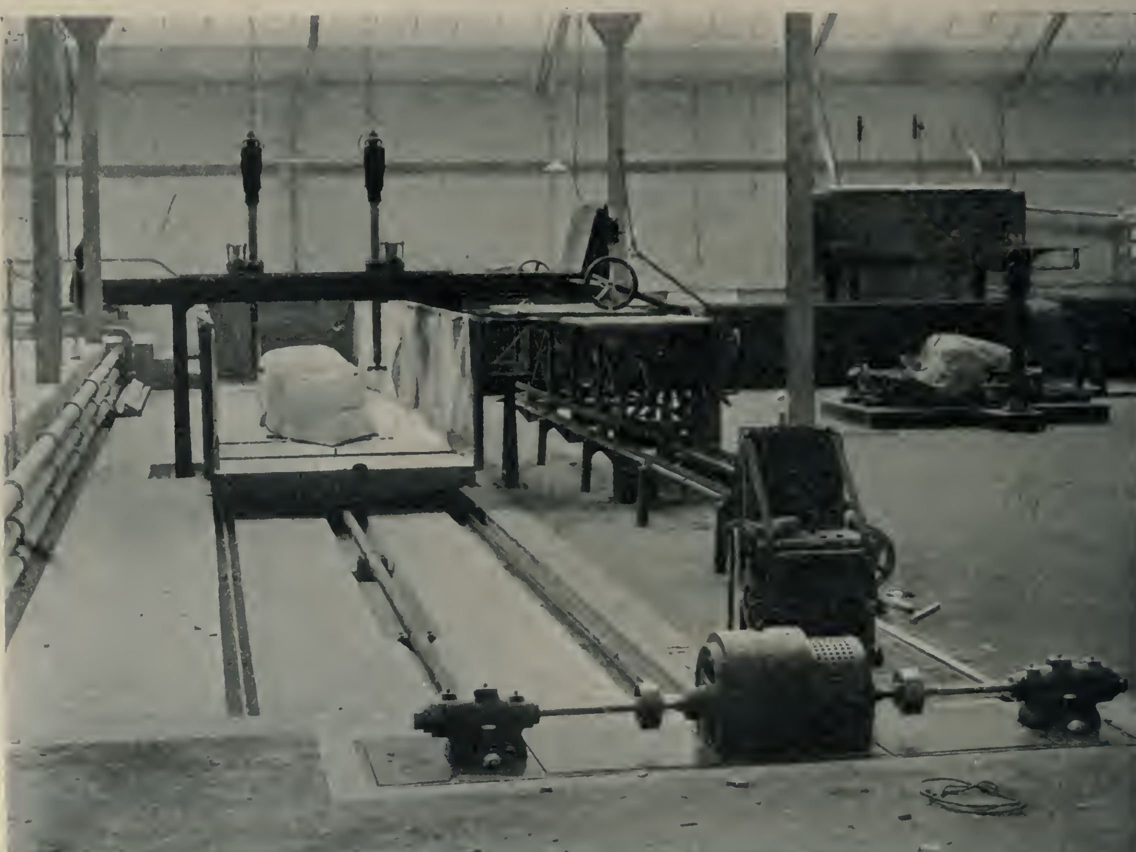


FIG. 2.—National Physical Laboratory Experimental Tank. Model-making Apparatus.

Suggestions for the establishment of a national experiment tank have been put forward from time to time by the council and various members of the Institution of Naval Architects, and among its chief advocates has been Sir William White. It is due to the munificence of Mr. A. F. Yarrow, a vice-president of this institution, that the proposal has become a reality, the whole of the first cost being defrayed by him. It will be largely supported by the leading shipowners and shipbuilders of the country, and will be open for the trials of any ship, but its chief purpose is to carry out research work in fluid resistance and ship propulsion. The site chosen for the tank is at Bushy Park, and it will be worked as a branch of the National Physical Laboratory.

[1] Dr. Froude's enunciation of this is as follows:—"If the ship be D times the 'dimension' (as it is termed) of the model, and if the speeds are V_1, V_2, V_3 . . . and the measured resistances are R_1, R_2, R_3 . . . then for speeds $\sqrt{D}V_1$, $\sqrt{D}V_2$, $\sqrt{D}V_3$ . . . of the ship, the resistances will be D^3R_1, D^3R_2, D^3R_3. . . . To the speed of model and ship thus related it is convenient to apply the term 'corresponding speed.'"

The chief features of the building are shown in Fig. 1. The main waterway is 30 feet wide, 12 feet 3 inches deep, and 500 feet long, clear of beach and docks, the latter being for storing models and for allowing access to them for ballasting and trimming purposes. The walls and floors are of concrete varying from 2 to 3 feet in thickness, except at the shallow docks, where the sides are 7 inches reinforced concrete.

A large steel carriage for towing the models has been erected across this waterway. It runs upon four wheels on rails which are bolted to continuous iron supports secured to the tops of the concrete walls. This carriage is driven by four motors—one over each wheel—the necessary power being obtained from conductors supported along the west wall of the building; these conductors are fed by a generator, which again is driven by a motor working on fifty-five cells. There are complete arrangements for controlling the voltage of the supply, so that the carriage may be brought to any speed up to fifteen miles per hour, and the speed be kept constant over the main portion of the run down the basin. This towing carriage will carry a dynamometer and other recording instruments for the measuring of the resistance, &c., of the models. These will be towed through the water in such a manner that though free to trim or move fore and aft to any extent necessary for equilibrium, no side motion will be possible, special guides being fixed under the carriage to ensure this.

The models will be made of hard paraffin wax of about 2 inches in thickness, the length being generally 20 feet, but varying according to the form. The paraffin wax is melted in a large tank through which hot water is circulated in pipes, and back through the surrounding casing, and the wax drawn off through pipes into a clay mould prepared to the shape of the model, but with an allowance of about a quarter of an inch for finishing.

The model when set is transferred to the shaping machine (Fig. 2). This machine works on the copying principle, and consists of two tables, each capable of being drawn longitudinally by a nut working on separate screws, which screws can be geared to revolve at any desired velocity. A plan of the ship is pinned on one table and the rough model secured keel up on the centre line of the second. Over this latter table there are two revolving cutters between which the model passes. Each of these is driven by a small electric motor attached directly to the upper end of its spindle. They can be set at any desired height, and their transverse motion be made to imitate (by means of a pantagraph mechanism), the lateral motion of a tracer, which the operator keeps in contact with the waterline on the plan corresponding to the height of the cutters on the model. By adjusting the fulcrum of this pantagraph, and the gearing between the driving screws, any proportion of length and breadth can be cut from the ship's drawing.

The model when it comes from the machine has upon it a series of horizontal guidance grooves, the wax between which is trimmed off with spokeshaves

FIG. 3.—National Physical Laboratory Experimental Tank. The small tank for still or flowing water experiments.

and a smooth surface obtained by the use of scrapers. This surface may be varnished or treated in any desired manner, and the model, after being ballasted and trimmed as necessary, is ready for an experimental run. A measuring table has also been installed, by means of which the lines of any model may be taken off, or the correct position for appendages may be marked on the model.

In addition to the main waterway already described, a smaller basin some 64 feet by 5 feet by $3\frac{1}{2}$ feet has been built (see Fig. 3). Experiments can be made in this with models up to 6 or 7 feet in length. These may be either propelled through the water the latter being at rest, or the model may be held at rest at the end of a dynamometer arm in the centre of the basin and the water caused to flow by it. A large power rotary pump has been fixed in this tank for this purpose.

The problems which remain to be solved by such a tank are many and wide. Chief amongst them are: the exploration of stream-line motion, frictional resistance on straight and curved bodies, the action and propulsive power of screws and the effect of form of hull, and size of waterway, on the resistance of a ship. Some of these fields have been partially explored already, but systematic research has not extended beyond the fringe of the remainder, and the rapid and continuous advance of naval science is ever bringing forward new problems.

That such a tank, though costly to establish and maintain, amply repays for its support, a single example will tell. It would not be a matter of much difficulty to effect an improvement of, say, 5 per cent. in the resistance or the propulsive efficiency of many ships of our mercantile navy. Such a saving in power would mean a reduction of 750 tons of coal on a yearly bill of 15,000 tons, and the whole cost of the upkeep of the tank now approaching completion at Teddington would be more than met by the consequent reduction in working expenses on some eight or ten ships.

UNIVERSITY EDUCATION IN LONDON.

THE second volume of evidence [Cd. 5528, price 3s. 8*d*.] has been issued by the Royal Commission on University Education in London, containing the minutes of evidence for the period June, 1910, to November, 1910, with numerous appendices. The first volume of evidence, published in April, 1910, contained the evidence from July, 1909, to the date of publication.

The appointment of this Commission, it may be recalled, originated indirectly from a letter reprinted in *The Times* of June 29, 1903, signed by Lord Rosebery, and addressed to Lord Monkswell, chairman of the London County Council, which directed attention to the failure to provide instruction and facilities for research in technology, and stated that Messrs. Wernher, Beit, and Co. had offered to place a large sum of money in the hands of trustees, to be applied as a contribution towards the cost of building and equipping an institution for advanced technology. The new institution, like the Royal College of Science and the Central Technical College, was to become a "school" of the University of London. Mr. (now Lord) Haldane conducted some negotiations on the subject with the London County Council, who undertook conditionally to support the new institution by an annual grant of £20,000.

At about that time the Board of Education was considering the future organisation and government of the Royal College of Science, and in April, 1904, the President of the Board, Lord Londonderry, appointed a Departmental Committee to consider and report on the question. The report of this committee, over which Sir Francis Mowatt, and later Mr. (now Lord) Haldane presided, recommended the establishment of a large college at South Kensington, to embrace the Royal College of Science, the Royal School of Mines, and the Central Technical College, and to take over, as it were, Lord Rosebery's scheme. On the question of the relation of the proposed college to the university, there was a division of opinion in the committee, for and against the incorporation of the college in the university. The senate of the university proposed certain changes in its own constitution in the direction of increasing the representation of technical interests, and at one time it appeared possible that the college would be incorporated in the university at its establishment. But in the result, the recommendation contained in the report of the Departmental Committee has been adopted; the college, known as the Imperial College of Science and Technology, was established by the Royal Charter in 1907 as a "school" of the university, and the question of its future relations to the university has been referred to a Royal Commission.

The Commission was appointed on February 24, 1909, with terms of reference of the widest character, corresponding to the title which it has taken, the Royal Commission on University Education in London. Lord Haldane is chairman, and the other members are Lord Milner, Sir Robert Romer, Sir Robert Morant, Mr. Laurence Currie, Mr. W. S. M'Cormick, Mr. E. B. Sargant, and Mrs. Louise Creighton. It is important to note the judicial character of the Commission—none of the members can be regarded as specially representative of any interest connected with university education in London. The evidence which is being published periodically acquires thereby an exceptional interest, for the findings of the Commission must be based, to an unusual degree, on the weight of the evidence tendered before it. The impartiality of the Commission is certainly reflected in the exceedingly able examination of witnesses by Lord Haldane and other members, which seldom suggests any bias for or against the contending opinions which have been expressed, though it may not always appear to show a friendly disposition to the existing organisation of the university in some of its aspects.

Within the limits of a short article, it is only possible to select a few of the more important questions on which evidence has been presented. The dominant issue is undoubtedly the constitution of the ultimate authority for the control of university education in London. Even such a simple statement as this assumes that, apart from the London County Council, whose statutory powers over higher education must not be ignored, there will be only one controlling authority, a matter on which opinion is by no means unanimous. The Commission has so far concentrated its efforts on this dominant issue, with its subsidiary questions of the constitution and powers of lower authorities, including faculties, board of studies, and committees.

Briefly stated, the main issue before the Commission in regard to the constitution of the ultimate governing body of the university relates to its principal characteristic, whether it should be representative or judicial. Evidence has been presented in favour of the creation of a large and representative court, with legislative functions, on the model of some of the northern universities, together with a small executive council, in the constitution of which no attempt would be made to represent all the interests existing in or related to the university. On the other hand, there is a large body of evidence which finds the solution of the present difficulties in a slight re-constitution of the present senate, including

the amendments proposed during the negotiations which followed the publication of the report of the Departmental Committee of the Board of Education. A special question, on which opinion is sharply divided, is whether the colleges incorporated in or affiliated to the university should be accorded direct representation on the senate. There appears to be fairly general agreement that the senate should have greater powers of delegation than are given by the existing statutes. The organisation of the faculties, composed of the teachers of the great groups of university studies in which degrees are granted, should, it is suggested, be made more effective, faculty boards being formed in the case of the larger faculties to exercise the administrative functions of the faculties. General approval has also been expressed of the existing organisation of the boards of studies for special subjects. The boards of studies, the faculty boards, and, lastly, an academic council, in which all the faculties would be represented, would form an administrative chain which would become largely responsible for the educational side of the work of the university, subject to the supreme control of the senate.

The existence of the external side of the university presents some difficulties in the way of such an organisation of the educational work of the university. Very little substantial evidence has so far been published in favour of the abolition of the system of external degrees, and a good deal of cogent reasoning has been adduced in its support. But it is admitted on all sides that the present statutory requirements for the equivalence of internal and external degrees have caused serious difficulties in practice, and that means should be found for averting these difficulties in the future. In this connection, the extension of the system of common examinations has been suggested, or, alternatively, the complete separation of the work of examination on the internal and external sides.

As already suggested, the Commission appears to be anxious to defer consideration of the future status of the Imperial College until some understanding is reached on other issues. Some interesting evidence has, however, been presented by Sir Alfred Keogh, on the actual working of the college. He states that it is the intention of the governing body to do nothing but post-graduate work eventually (Question 4521), and to get rid of the elementary students. As the evidence of the governing body has not yet been published, it will be wise to defer discussion of this policy for the present, except for the remark that its adoption will have far-reaching effects on the work at present carried on at South Kensington. Some valuable reports on the future work of the various departments of the college, prepared for the governing body, including a report on the organisation of a department of applied science, are printed in an appendix to the volume of evidence.

It should be mentioned, in conclusion, that the volume contains a large amount of information in regard to university work in London and elsewhere, both in its educational and financial aspects. Full statistics relating to the work of the University of London are printed in the reports of the various councils, faculties, and committees, which are included in the volume. Conditions in the United States and Canada are described in the evidence of President Murray Butler, of Columbia University, New York, and Principal Petersen, of the McGill University, Montreal.

BRITISH SHEPHERDS AND THEIR FLOCKS.[1]

IN this volume, which, as stated on the title-page, mainly consists of extracts from the writings of others, the author has succeeded in bringing together a large amount of valuable and interesting information concerning, not only the shepherds, but likewise the sheep, of the British Isles. In regard to the latter item, Miss Gosset has certainly not done herself justice in the title she has chosen, and it may perhaps be permissible to suggest that a better designation would have been the one standing at the head of this review. Neither, perhaps, has she conveyed an adequate idea on the title-page of her own contributions to the volume, at least one of which, namely, the article on sheep and shepherding in the Isle of Man, contains much interesting and little-known information.

Nor do shepherds and sheep by any means exhaust the contents of this fascinating volume, for we find a large collection of articles on sheepdogs, with others relating to shearing, to wool in connection with manufactures, and yet others on the arts, implements, crafts, and pastimes of shepherds, with a final series on pastoral folklore. There appears to be no mention in the index of black-horned sheep, which are stated

Mr. J. C. Bacon's Flock of Loughton Manx Sheep. From "Shepherds of Britain.

in the preface to include some of the oldest British breeds; but possibly the author intended to write black-faced in place of black-horned. With this exception there seems no fault to be found with the book.

Since sheep-farming has for several centuries been one of the most important industries in the British Islands, it is not a little curious that it has been reserved for the author—as she herself remarks—to treat of shepherds and their flocks in the full manner such an interesting subject undoubtedly demands. The charms of shepherd-life (with allusions here and there to its obvious discomforts and trials at certain seasons and on certain occasions), and the manners, customs, and nature-lore of the old-time shepherd—who, by the way, is fast disappearing from the face of the country, at least in our southern counties—are illustrated by a series of apposite extracts from a number of well-known writers on country life, among whom may be specially mentioned the late Mr. Richard Jefferies and Mr. W. H. Hudson. Several of these contain some delightful anecdotes, while others serve to bring out the accurate and comprehensive

[1] "Shepherds of Britain." Scenes from Shepherd Life, past and presen From the best authorities, by Adelaide L. J. Gosset. Pp. xxiv+331. (London: Constable and Co., Ltd., 1911.) Price 7s. 6d. net.

knowledge of climate, stars, plants, and nature generally possessed by the old-fashioned shepherd, who, as I have mentioned on a previous occasion, was, despite his frequent inability to write or read, thoroughly and completely educated and equipped for the purposes of his calling.

Much has been made in works on the Bible and in sermons, of the fact that Syrian shepherds lead, instead of driving, their flocks; but, as the author points out, and as everyone who has lived in the country ought to be aware, this is by no means a peculiarity of Eastern lands. Very interesting are the notes on sheep-bells, which are stated to date from a remote antiquity, and it is therefore the more remarkable to find that they are apparently unknown in the Isle of Man and Scotland. With this I must take leave of a delightful book. R. L.

DR. ALEXANDER BRUCE.

NEUROLOGY and medicine have sustained a heavy loss in the death of Dr. Alexander Bruce, of Edinburgh, physician and editor of *The Review of Neurology and Psychiatry*. It was known for some time that Dr. Bruce was in ill-health. The news of his death, however, came as a shock to many.

Born in Aberdeenshire in 1854, Dr. Bruce entered the arts faculty of Aberdeen University in 1870. He graduated in 1874 with first-class classical honours, being awarded the Town Council gold medal as the most distinguished graduate of his year. He had an equally brilliant career in medicine at Edinburgh University, and, on his graduation in 1879 as M.B., C.M., with first-class honours, he obtained the Ettles Scholarship as the best student of his year. During his tenure of the Leckie-Macteir Fellowship he studied at Vienna, Heidelberg, Frankfort, and Paris.

Returning to England, he commenced his professional career by being for a time assistant clinical clerk at the West Riding Asylum, Wakefield. In 1882 he took his M.D. degree, obtaining a gold medal for his thesis. Settling in Edinburgh, he gradually built up a large general practice. He became a lecturer on pathology at the Surgeons' Hall and pathologist to the Royal Infirmary, to the Royal Hospital for Sick Children, and to the Longmore Hospital for Incurables. He also lectured at the Surgeons' Hall on neurology, and later on the practice of medicine, while he was appointed a physician and lecturer on clinical medicine at the Royal Infirmary.

By this time he had acquired a considerable reputation as a consultant, especially in diseases of the nervous system. His contributions to the literature of this subject were very numerous, being marked especially by the care with which pathological lesions were investigated and described. The chief characteristic of his work was thoroughness, and in the preparation of these published reports of cases no labour, whether of bedside observation or of microscopic work, was spared. He did not restrict himself to neurological subjects, but published communications on general pathology and medicine. He also translated Thoma's "Lehrbuch der Pathologie."

It was characteristic of Dr. Bruce that he should undertake pioneer research into the minute anatomy of the brain and spinal cord. It is with this work that his name will perhaps be most associated. He began by publishing "Illustrations of the Mid and Hind Brain" and "Topographical Atlas of the Spinal Cord." Numerous researches on the nuclei of the cerebral and spinal nerves, on cranial nuclei, and on the nerve-fibre connections of these we owe to him. A notable example of this work is "Distribution of the Cells in the Intermedio-Lateral Tract of the Spinal Cord" (Trans. Roy. Soc., Edin., 1906), a research which must form the basis of all subsequent work on this subject. Feeling the need of a "Centralblatt" in English which should contain short, original communications and provide abstracts and a complete bibliography of recent work on neurological subjects, he founded in 1903 *The Review of Neurology and Psychiatry*. To the interests of this work he devoted a large part of his time, with what success only those who work on neurological subjects can adequately appreciate. Just before his last illness he had finished a translation into English of Oppenheim's great "Lehrbuch der Nervenkrankheiten," while he was busily engaged, along with Dr. Dawson, in an investigation on the lymphatics of the spinal cord.

Dr. Bruce was a strenuous worker. It was only by systematic economy of his time that he was able to keep abreast of his multifarious duties. His influence over the younger workers with whom he was associated was great. Among his *confrères* he was held in highest respect, as well for his uprightness and generosity as for his ability. As a mark of his distinction in neurology he was in 1899 made a corresponding member of the Neurological Society of Paris. In 1906 the Royal Society of Edinburgh awarded him the Keith prize for his work on the intermedio-lateral tract, and in 1909 the University of Aberdeen conferred on him the degree of LL.D. He is survived by a widow, two daughters, and three sons, one of whom has already made important contributions to neurological science.

NOTES.

THE council of the London Mathematical Society has awarded the De Morgan medal for 1911 to Prof. H. Lamb, F.R.S., in recognition of his researches in mathematical physics.

THE British Empire League and the British Science Guild are combining to entertain the Colonial Prime Ministers and other distinguished visitors at a banquet at the Savoy Hotel to-morrow, June 16. His Grace the Duke of Devonshire (president of the British Empire League and vice-president of the British Science Guild) will take the chair.

THE annual meeting of the Association of Economic Biologists is to be held at the rooms of the Linnean Society, Burlington House, London, on July 6.

ACCORDING to the June number of *The Selborne Magazine*, the annual conversazione of the Selborne Society held in London on May 5 was the most successful of the whole series. It was announced that the original MS. of Gilbert White's Nature Calendar is to be published shortly.

MR. FRANK A. PERRET, of Springfield, Mass., is proceeding to Hawaii to open and take charge of the volcanic observatory which has been established there through the combined efforts of the Massachusetts Institute of Technology, the Smithsonian Institution, and the Carnegie Institution of Washington.

A PROPOSAL will be laid before the members of the Aëronautical Society to reconstitute the society by the institution of the following five grades of membership, viz. ordinary members, associate members, fellows, associate fellows, and students, the last three categories being reserved for persons engaged in technical work connected with aëronautics, while the first two are open to all who are interested in the work of the society.

THE death is reported, in his seventy-fourth year, of Dr. Cyrus G. Pringle, botanical collector to Harvard University and curator of the herbarium of the University of Vermont. His best known work was done in connection with the exploration of the flora of Old Mexico, about fifty of the most important herbaria in the world having benefited by his researches in that country. Before his Harvard appointment he was a collector for the American Museum of Natural History in New York.

THE vessel carrying the collection of wild animals presented to H.M. the King by South Africa arrived in the Thames on June 1. The collection, which was brought home in charge of two keepers sent out by the Zoological Society, is stated to include about 200 animals. These are now housed in buildings specially erected for their reception in the Zoological Gardens, Regent's Park, and are exhibited to the public as the King's South African collection. They were inspected by the King on June 4.

REPRESENTATIVES of the Hessian Government, of the town of Darmstadt, and of numerous chemical works joined with many others on June 1 in congratulations to Dr. Willy Merck, of E. Merck, Darmstadt, upon the celebration of the twenty-fifth anniversary of his entry into the firm as a partner. In the name of the Grand Duke of Hesse, the representative of the Hessian Government handed to Dr. Merck the grand medal for art and science conferred upon him in recognition of his services, not only in promoting the advance of chemical research work and in developing this branch of the country's industry, but also as a distinguished patron of art.

MR. HARVIE BROWN writes to us suggesting that the great Scots pine trees on Auchnacarry are probably of much greater age than the two hundred or three hundred years at which they were recently estimated in our columns (June 1, p. 447). Mr. Harvie Brown is very probably in the right. But we are informed by the timber merchants, Messrs. Souness and Spiers, Edinburgh, that they will be at work in the forest within the next two or three weeks, and that plenty of trees and logs will then be available for ascertaining the actual age.

A BILL has been introduced in the House of Representatives of the United States of America "to establish in the District of Columbia a laboratory for the study of the criminal, pauper, and defective classes." We understand from Mr. Arthur MacDonald, of Washington, who has been prominent in advocating the establishment of such laboratories, that the Russian Government has already set aside a large sum of money for this purpose. The fundamental problem in such studies, it seems to us, is to determine which individuals among the criminal, pauper, and feeble-minded population occupy that position through accidental misfortune, and which are congenitally defective. It is useless, or worse, to spend money in the hope of curing the latter class. Permanent care and control is for them the only hope, and for society the most feasible way of preventing the ever-growing burden of their criminal or incompetent descendants.

A VIOLENT earthquake occurred in Mexico on June 7 at 4.35 a.m., and gave rise to unusually large disturbances in distant seismographs. In Mexico city many poorly-built houses were destroyed, and 172 persons were killed. The shock or shocks lasted there for about six minutes. The total number of deaths is estimated at 1300, of which 500 occurred at Zapotlan. The volcanoes of Colima and Popocatapetl are also said to be in active eruption. The position of the origin is still unknown. An earthquake capable of affecting European seismographs so strongly must have caused widespread destruction in the central area, and it is possible that this area may be isolated from the surrounding country, so that the full extent of the disaster may not be realised, or, for political reasons, detailed telegrams may be censored. It is clear, however, that the epicentre was at some distance from those of the Mexican earthquakes of 1905 and 1907. In those years the towns which suffered most were Chilpancingo and Acapulco, which lie from 200 to 250 miles south of Mexico city. Zapotlan is about 275 miles west of that city, and is situated in a well-known seismic district, having on several occasions been damaged or destroyed by earthquakes.

FOR the use of the members of the sixteenth annual Congress of the South-Eastern Union of Scientific Societies, held at St. Albans last week, the Hertfordshire Natural History Society and Field Club has issued an excellent guide to the topography, natural history, archæology, &c., of the city and the surrounding neighbourhood, the account forming part iii. of vol. xiv. of the society's Transactions. Mr. John Hopkinson has acted as editor, and has himself contributed the sections on topography, geology, hydrology, and climate, while the other sections have been written by various members of the society. The guide is illustrated by a map of the district, a plan of modern Verulamium, and several local views, and will be of permanent value to residents in and visitors to the neighbourhood. The congress lasted from June 7 to 10, and at the inaugural meeting a resolution was passed expressive of the hope that the negotiations between the Society of Antiquarians and the Earl of Verulam for the excavation of the site of Verulamium, which—owing in part to the death of King Edward—fell through last year, may be resumed and brought to a successful issue. Lieut.-Colonel D. Prain, F.R.S., was nominated president of next year's congress in succession to Sir David Gill, K.C.B., F.R.S.

THE Huxley lecture at the University of Birmingham was delivered this year, on May 29, by Prof. Henri Bergson. He chose "Life and Consciousness" as the subject of his lecture. He proposed the view that a world-wide antagonism exists between matter, which is essentially automatic and governed by necessity, and consciousness, which is characterised by the power of choice and creation. Consciousness, he believed, entered matter in order to entice it to organisation; but in thus binding itself to matter, consciousness lost much of its original liberty, and was continually being dogged and cramped by automatism. Prof. Bergson conceived consciousness as flowing through matter much as a stream of fluid flows through a tunnel; in digging galleries in this hard rock, consciousness found itself impeded at point after point. Thus it had repeatedly to make fresh starts in its ceaseless efforts to create, until finally, in the course of this crooked path of evolution, it created man. In man alone, the chains which elsewhere bound consciousness to matter were broken. Here, maintained the lecturer, every contracted habit could be opposed by another habit, every kind of automatism by another automatism. Consciousness thus acquired its liberty by setting one necessity to fight another. In this way it has expanded to such a state of freedom that in man, perhaps, it may be able to endure beyond his earthly life.

THE fine series of big-game and other sporting trophies arranged in a special building at the Festival of Empire and Imperial Exhibition at the Crystal Palace, and opened

to the public last week, is of interest from two points of view. It is, for instance, the first attempt to bring together in this country a collection of the big-game animals (exclusive of zebras, wild asses, and giraffes) to be found within the limits of the British Empire, while, in the second place, it includes many of the finest heads of animals of this nature which have fallen during the last thirty or forty years to the rifles of (mainly British) sportsmen. Although it was found impossible to render the series absolutely complete, the exhibition affords an excellent idea of the wonderful extent of the big-game fauna of Greater Britain, and how vastly it exceeds that of any other empire in the world. The specimens are arranged according to countries, and thereby afford an excellent object-lesson in geographical zoology, so far as it can be learnt from a few groups of mammals. Those who visit the Crystal Palace exhibit will at once realise how much is lost by the lack of a geographical section in the zoological department of the Natural History Museum. A considerable proportion of the specimens exhibited at the Crystal Palace were shown last year at Vienna, but, on the other hand, there are many new objects, a few of which are of more than ordinary interest. To particularise these on the present occasion is, however, out of the question, and we may conclude by offering congratulations to Lord Wolverton, the president, Mr. C. E. Fagan, the hon. organising secretary, and the other promoters of this extremely successful and instructive exhibition.

WE have received a booklet entitled "Vergiftungen durch Tiere und animalische Stoffe," by Dr. Kanngiesser (Jena: Gustav Fischer, 1911, price 1 mark), which gives a brief but simple and comprehensive survey of animal poisons, *e.g.* those of insects and arthropods, molluscs, fish and toads, snake venom, &c. Some of the subjects, however, being infections rather than intoxications, *e.g.* amœbic dysentery, coccidiosis, trypanosomiasis, and trichinosis, seem somewhat out of place.

IN a review on "Salvarsan" which appeared in NATURE of May 25 (p. 412), it was stated that Ehrlich had introduced trypan red for the treatment of piroplasmosis. Prof. Nuttall writes pointing out that this is an error; it was tried by Ehrlich for the treatment of trypanosomiasis. Trypan red was first used by Prof. Nuttall in conjunction with Dr. Hadwen for the treatment of canine piroplasmosis, but proved unsatisfactory, and trypan blue, a drug which emanated from Mesnil, has been used instead with considerable success in the treatment of piroplasmosis in different parts of the world.

NO. 42 of the Scientific Memoirs of the Government of India deals with the cultivation of the leprosy bacillus. The cultivation of this micro-organism has almost baffled investigators, only a few undoubted cultures having been obtained. Major Rost makes use of a culture medium prepared by steam distillation of rotten fish, and to this distillate some weak Lemco broth and milk are added. Inoculated with material from leprosy patients, masses of "acid-fast," leprosy-like bacilli develop in a few days. Captain Williams, using Major Rost's medium, or a somewhat similar one, in which distilled water replaced the fish distillate, has also obtained cultures of what he considers to be the leprosy organism. An interesting fact brought out by the work is the extreme variation of the leprosy organism; sometimes it has the ordinary bacillar form and is "acid-fast," at others it is non-acid-fast, while diphtheroid and streptothrix forms frequently appear, the streptothrix often breaking up into bacillar forms. Both these observers have prepared vaccines with which promising results, as regards the cure of the disease, have been obtained.

IN the report of the Horniman Museum and Library for 1910 attention is directed to the gift, by Mr. A. R. Brown, of a number of specimens illustrative of the ethnology of the Andaman Islands. During the year, the museum has lost the services of Mr. F. Slade, whose appointment as naturalist considerably antedates the transference of the institution to the County Council.

IN an article in the May number of *The Museums Journal*, Dr. Bather directs attention to the palæontological exhibit at the "White City," the leading idea of which is to display the scientific results attained by the study of palæontology, and more especially such as can be obtained only by means of this science. The restoration of extinct animals constitutes one section of the exhibit; a second is devoted to extinct faunas and floras in connection with their bearing upon the present distribution of animal and plant life upon the surface of the globe; while a third section illustrates contemporary individual variation in a species. The last-named feature leads on to the evolution of species and genera, which is also exemplified by actual examples.

The Scientific American of May 11 contains an illustrated account on the so-called "dinosaur-mummy"—that is to say, a skeleton of Trachodon still covered with the skin obtained in 1908 by Mr. C. H. Sternberg from the Cretaceous of Wyoming. One of the illustrations shows the finely tuberculated, or granulated, structure of the external surface of the skin, while a second reproduces the latest restoration of the entire animal. The tenuity of the skin suggests aquatic habits on the part of these dinosaurs, and this view is strengthened by the circumstance that the relatively small fore-legs terminated in a broad expansion of the skin, converting the toes into a kind of paddle, and projecting beyond their tips. The expansion of the extremity of the muzzle into an edentulous, duck-like beak seems likewise indicative of aquatic habits.

To *La Nature* of May 27 Dr. E. Trouessart contributes an account of a specimen of the New Guinea long-beaked Echidna (*Zaglossus*, or *Proechidna*, *bruyni*) now living in the Zoological Gardens at Amsterdam, which is probably the first example of its kind ever brought alive to Europe. It belongs to the race for which Mr. Rothschild proposed in 1892 the name *Z. b. nigro-aculeatus*. The communication is illustrated by two photographs, which show that the pose of the creature is quite different from the one given in pictures and mounted specimens. In these the animal is represented with the belly resting on the ground, and the claws of the hind-legs directed like those of a lizard. In reality, it stands up on its legs in elephant-fashion, with the hind-claws directed outwards and slightly forwards, this being a remarkable attitude for a burrowing animal. Unlike the ordinary echidna, which refuses to touch them, the long-beaked species exhibits a marked partiality to earth-worms.

A PALÆONTOLOGICAL communication by Mr. E. W. Berry, published in the Proceedings of the United States National Museum (No. 1821), presents a revision and reduction of species referable to fossil gymnospermous genera from the Potomac group. Of eight genera reviewed, Sequoia is represented at the present day, Arthrotaxopsis and Cephalotaxopsis indicate by their names their relationship to modern genera, Brachyphyllum and Sphenolepis are *sedis incertæ*; the two latter genera are

possibly composite. Cones and seeds of a pine, *Pinus vernonensis*, are abundant in the group.

The modification of plants induced by the extremely dry summer in West Australia furnishes the subject of a contribution by Dr. A. Morrison to the Journal of the Natural History and Science Society of Western Australia (vol. iii., No. 1). A thick development of woolly hairs on stem and leaves is shown by *Eragrostis eriopoda*; rolling back of the leaf margins is the device exhibited by *Grevillea oxystigma*; *Plagianthus Helmsii* furnishes an instance of extreme specialisation in an arrangement of closely set minute leaves. *Daviesia euphorbioides* is an interesting case of a leguminous plant which has developed a succulent cactus-like form, while *Calandrinia primuliflora* is provided with a water-storing tubercle.

The concluding portion of Dr. C. B. Robinson's article on Philippine Urticaceæ, published in *The Philippine Journal of Science* (Botany, vol. vi., No. 1), contains the diagnosis and illustration of a new generic type, Astrothalamus, segregated from Maoutia, and several new species, notably under the genus Leucosyke. In the same number Mr. O. Ames presents a list of new records and species of Orchidaceæ, with an introductory note summarising his conclusions regarding the orchid flora of the Philippines. Dendrochilum, Dendrobium, and Eria stand out as the most important genera. No genus is entirely confined to the islands, but the numerous species contained in one section of Dendrochilum are all endemic.

The current number of *The Gardener's Chronicle* (June 10) contains the first part of an article by Mr. H. N. Ridley, describing a botanical expedition to Lower Siam, undertaken with the object of demarcating the boundary between the two distinct floras of Malaya and Tenasserim. On the island of Alostar the northern element was already recognisable in the shape of a common species of Corypha palm and a yellow vetch, a species of Geissaspis, growing as a weed in the rice fields. *Crinum Northianum* and a Lepadanthus were notable discoveries, as also the growth of *Leea rubra* in the mud flats. Attention is also directed to a contribution by Mr. R. Farrer, presenting a systematic synopsis of European species of Primula, with the object of clearing up some of the confusion which exists owing to changes in nomenclature.

Various problems, mainly economic, are discussed by Mr. A. D. Blascheck in an article contributed to *Science Progress* (April) on the subject of afforestation in the United Kingdom. He proceeds to show that the climate is suitable, that land is available, and that Great Britain has a smaller proportion of land under forest than any other European country. But the crux of the situation lies in the financial aspect, with reference to which the opinion is expressed that forests, as a rule, yield less profit than Government securities, so that the benefits derivable are indirect, chiefly in the extra employment of workers required for the timber and allied industries. These arguments lead to the recommendation of measures that were proposed in the Development and Roads Improvement Funds Act, 1909, *i.e.* "the conducting of inquiries and research for the purpose of promoting forestry and the teaching of methods of afforestation," as also "for the purchase and planting of land found after inquiry to be suitable for afforestation."

Mr. F. Muir has recently published an account, in Bulletin No. 9 of the Experiment Station of the Hawaiian Sugar Planters' Association, of some new species of leaf-hopper (Perkinsiella) on the sugar-cane. The genus was investigated by Kirkaldy in 1903; it is particularly attached to the sugar-cane, and only occasionally goes on to other grasses. At present there are thirteen known species.

Mr. L. D. Larsen has recently collected his work on the diseases of the pineapple, and published it as Bulletin No. X. of the Hawaiian Sugar Planters' Association. The fungus *Thielaviopsis parodoxa* is by much the most destructive micro-organism involved, causing three distinct and important diseases, in addition to being responsible for a good deal of the decay in pineapple roots. It is in general saprophytic, but in certain conditions it becomes parasitic. A disease known as brown rot was traced to Fusarium. The fungus causing the very serious pineapple wilt is not yet isolated with certainty.

The fifth annual report of the work at Rosslynlee, by Messrs. Lauder and Fagan, on the variation in composition of cow's milk, shows what a small effect ventilation of the cowshed has on the yield of milk. The shed was divided by a wood and felt partition into two parts, one of which was freely ventilated, even in the coldest weather; the other was only partially ventilated, so that its average temperature was higher by about 9° F. In the cool, well-ventilated part the average yield per cow per day was 27·54 lb., and in the warm, badly ventilated part it was 27·14 lb., the percentages of fat being respectively 3·74 and 3·70.

Messrs. Schreiner and Skinner have published, in Bulletin No. 75 of the United States Bureau of Soils, an account of the soils most suitable for lawns in the United States, and of the detailed cultivation and manuring necessary to obtain a good growth of grass. Some of their recommendations, however, seem quite inconsistent with the official views of the Soil Bureau; thus their advice to use phosphatic manures seems intelligible only on the old view that phosphates are needed to feed the young plant. It is significant that gardening has become of sufficient importance in American life for a great State department to undertake such an investigation as the present one.

An article by Dr. H. v. Ficker on the interesting subject of the advance of cold waves in Asia and Europe appears in the Proceedings of the Vienna Academy of Sciences for December last. The data upon which it depends are drawn chiefly from the Russian Meteorological Annals for 1898–1902. About fifty cold waves were investigated, and nearly 200 charts drawn, in this laborious work; a few typical cases only, with charts, are included in the article, with a short discussion of the majority of the other periods. The greater frequency of cold waves in winter would lead one to suppose that they proceeded from the cold centre in north-east Siberia, but this view has not been confirmed. In the majority of cases they were found to come from the Arctic coast, between long. 30° and 90° E. Distinction is drawn between those proceeding from the west of Novaia Zemlia, accompanied with north-west winds, and those proceeding from the east of that island, accompanied by north-east winds. The spread of the cold air is found to take place earlier towards Europe than towards Siberia. The maximum velocity of the waves is about twenty-five miles an hour, and thus corresponds fairly well to the rate of propagation of thunderstorms. Their irruption causes a sharp rise of the barometer; they are preceded by low pressure, and generally with a rise of temperature.

The classification of the visible forms of the various sextic plane curves forms the subject of a paper by M. W. Sierpinski in the *Bulletin international* of the Cracow Academy, No. 10 A (1910).

THE Proceedings of the Royal Society of Edinburgh, xxxi., 3, contains three papers by Dr. T. Muir, F.R.S., dealing with the historical development of certain determinants up to 1860. The papers refer respectively to "Wronskians," "Recurrent Determinants," and "The less common special Forms."

IN two notes contributed to the *Atti dei Lincei*, xx., 5, 7, Dr. U. Cisotti works out *in extenso* the solution of the problem of discontinuous stream-line motion of a jet which is divided in two by impact on a fixed plane, the jet being of finite breadth and bounded by free stream lines.

IT is announced that after the close of the present volume the *Annals of Mathematics*, hitherto published in October, January, April, and July, under the auspices of Harvard University, will be transferred to Princeton University, New Jersey, to which address editorial and other communications are in future to be sent.

IN the Bulletin of the American Mathematical Society for May Prof. Florian Cajori publishes a paper in which it is claimed that the now familiar "Horner's method" of solving an algebraic equation had been previously given by Paolo Ruffini in an Italian paper. The methods adopted by Ruffini and Homer seem to have been identical to a very great extent; the main differences which Cajori mentions are that Horner explained a special procedure for separating a pair of nearly equal roots, and, further, that he contemplated the application of his method to transcendental equations. It need hardly be pointed out that the solutions of such equations as $\tan x = x$, which can be expanded by Taylor's theorem, constitute some of the most useful and well-known applications of Horner's method.

WE have received a copy of Mr. W. J. Lyons's paper read before the Royal Dublin Society recently on a method of exact determination of the continuous change in absolute density of a substance in passing through its fusion stage. The apparatus consists of a dilatometer bulb, from the lower end of which a capillary issues, and is bent first upwards and then horizontally. This tube and the lower part of the bulb are filled with mercury. The upper part of the bulb contains the substance the expansion of which is to be determined, and the magnitude of the expansion is calculated from the motion of the mercury meniscus in the capillary tube. Experiments on wax show that the fusion lasts over a considerable range of temperature, and that in the neighbourhood the volume on cooling is, at the same temperature, greater than on heating. As the apparatus only differs from Pettersson's of 1881 in the absence of taps for the admission of the substance, it is to be regretted that Pettersson's name is not mentioned in the paper.

THE address given by Prof. Planck to the Société française de Physique on April 21, and reproduced in the May number of the *Journal de Physique*, constitutes one of the clearest expositions we have seen for some time of the present difficulties of the attempt to express the relation between energy and temperature. The doctrine of the equipartition of energy amongst the various degrees of freedom of a molecule, deduced by Boltzmann and Gibbs, has led to serious difficulties owing to the smallness of observed specific heats as compared with the calculated values. Planck's own theory, that energy exists in multiples of a certain atomic quantity, leads to difficulties with regard to absorption of energy, and, as we pointed out in these columns on March 16 (p. 90), he has now modified it so that only emission takes place by the step by step process, absorption being continuous and energy content of a body no longer an integral multiple of the atomic energy. Whether this change gives us a satisfactory theory only time can show.

The Builder for June 9 contains an illustrated article, by Mr. Percy J. Waldram, on the need for horizontal tie-rods in arched timber roofs. Generally, the introduction of such rods is owing to the designer assuming that the joints are flexible, and constructing a force-diagram based on this assumption. Actually, the stiffness of the joints as constructed in practice renders the fitting of tie-rods quite unnecessary in a properly designed arched roof. The author cites the case of the fine arched hammer-beam roof of Eltham Parish Hall, which has no tie-bars, and gives account of an interesting experiment carried out on one truss, which was mounted on pipe rollers on the ground and loaded with bricks laid on a platform slung from the truss. With a span of 42 feet and a load of 7 tons the calculated outward spread was 0·63 inch. Upon the first application of the load, the spread was found to be slightly more than 1 inch, owing partly to the tightening up of the joints. On removing the load, the truss came back 0·75 inch, and in each of the two reimpositions of the load, at intervals of two days, the spread was found to be 0·75 inch. The object of the test was attained, inasmuch as the district surveyor withdrew his requisition for tie-rods.

THE report of the Indian Association for the Cultivation of Science for the year 1909 has now been received. The association's chief work seems to be the arrangement of lectures on scientific subjects. During the year about 280 lectures on various branches of physics and chemistry were delivered, and in addition upwards of a hundred practical demonstrations were arranged. The chemical laboratory conducted by the association has been remodelled, and it is hoped soon to inaugurate a research department. The report also contains a set of meteorological observations taken at Calcutta during 1909.

IN a review of Prof. Leduc's book on biological aspects of osmotic phenomena in NATURE of May 25 (p. 410) the writer gave examples of the need of proof-reading, and stated that there were errors in the title of a book by Rhumbler. He inferred, unfortunately without verification, that the strange words "organismischer" and "anorganismischer" were typographical errors, but Prof. Leduc writes to point out that they are the words Rhumbler used in his title. The reviewer regrets that he was guilty of the kind of carelessness for which he reproached Prof. Leduc, but he is afraid that his remark as to misprints remains true.

OUR ASTRONOMICAL COLUMN.

A REMARKABLE METEORIC PHENOMENON.—In No. 4503 of the *Astronomische Nachrichten* Dr. Max Wolf describes a curious phenomenon observed on May 22, at about 11h. 49m. (Königstuhl M.T.), at Heidelberg. A faint meteor, pursuing a 4° path obliquely from east to west, passed over the star γ Aquilæ with great velocity; its breadth was about 15′, and it left a faint trail, which disappeared immediately. But although this trail was only momentarily visible, the star remained invisible for at least 3·5 seconds, its light apparently cut off by the material left behind by the evanescent meteor.

THE DIFFERENT QUALITY OF THE LIGHT REFLECTED FROM DIFFERENT PARTS OF THE MOON'S SURFACE.—The results obtained by Herren A. Miethe and B. Seegert in photographing the moon's surface through colour-selective screens are further described in No. 4502 of the *Astronomische Nachrichten*, and illustrated by a two-colour

reproduction of a composite drawing made from their photographs. On this drawing those parts which reflect a greater amount of light from the red end of the spectrum are shown in red, and those which reflect chiefly light of shorter wave-length are represented in green. The complex mixture of colour cannot be described in detail here, but we note that the walls and several streaks about Tycho are red, as are also the greater parts of the Mare Serenitatis and the Mare Humorum. On the other hand, Tranquilitatis, Fecunditatis, and Crisium are almost wholly green, while the Mare Imbrium is quite an intricate mixture.

THE SILVER DISC PYRHELIOMETER.—In 1909 Mr. Abbot, director of the astrophysical observatory of the Smithsonian Institution, designed a pyrheliometer which, although not readily providing results reducible to calories per sq. cm., furnishes readings proportional to the intensity of the solar radiation, and can be made of a standard form, so that a number of widely distributed observers may work in consonance. This instrument, as described in No. 19, vol. lvi., of the Smithsonian Miscellaneous Collections, consists of a silver disc in which a radial hole has been bored. Into this hole a thermometer bulb is inserted and packed, a mercury filling ensuring good conduction. The whole is carried in a tube provided with suitable diaphragms, exposing shutters, and packing, on an equatorial stand, and the observations simply consist of reading, very carefully, the thermometer at definite intervals. In order to secure cooperation, the Smithsonian Institution has furnished several other institutions with copies of the standard instrument, and is willing to furnish others. Standardised and packed ready for shipment, such an instrument costs the institution about 100 dollars.

THE PHOTOGRAPHIC DETERMINATION OF STELLAR MAGNITUDES.—Two sections of the Harvard College Observatory Annals recently received deal with the difficult but important question of the determination of stellar magnitudes by photography.

In No. 1, vol. lxxi., Prof. E. C. Pickering discusses the numerous difficulties attending the determination of standard magnitudes, and briefly reviews the various methods that have been tried. He then shows by tables and curves that the method adopted at Harvard, in which the photographic magnitude can be derived from the photometric by adding a constant depending upon the class of spectrum of the star, gives results in which the deviations, at least for the brighter stars, are probably too small for determination at present. A comparison of the results obtained by thus treating the magnitudes given in the Uranometria Oxoniensis and the Potsdam Catalogue shows the smallness of the residuals. The photographic magnitudes of all stars of mag. 4·25 and brighter from these two catalogues and the Harvard Revised Catalogue are given in Table V., and should prove a useful reference for standard photographic magnitudes; other tables give the magnitudes of double stars and of stars having a photographic magnitude of 3·0 and brighter. The paper concludes with an interesting note on the apparent changes well-known groups of stars would undergo if we saw their photographic, instead of their photometric, brightness; Betelgeuse would become from 0·5 to 1·0 mag. fainter than the belt stars; Antares would appear a little less bright than σ and τ Scorpionis, and the Southern Cross would be greatly altered by γ Crucis becoming much fainter than δ.

In No. 6, vol. lix., Mr. E. S. King gives the photographic magnitudes of 153 stars determined by the method of measuring images taken at different foci; these magnitudes are absolute, and the scale is independent of any other system. The determination of these absolute magnitudes provides a surer basis for the derivation of the constant corrections to be applied to existing photometric magnitudes according to the class of spectrum, and these corrections are tabulated. Mr. King also discusses his material to educe evidence of the absorption of light in space, and finds, from the increased redness of the more distant stars, that there probably is some such absorption.

JUPITER'S EIGHTH SATELLITE.—The eighth satellite of Jupiter was observed at Heidelberg on May 22, and at 10h. 26·2m. (Königstuhl M.T.) its position (1855·0) was 14h. 19m. 37·4s., −13° 56·8′. Its magnitude was between 16 and 17, and Dr. Wolf remarks that its position is so low as to place its observation with the reflector on the limit of possibility, mechanically (*Astronomische Nachrichten*, No. 4503).

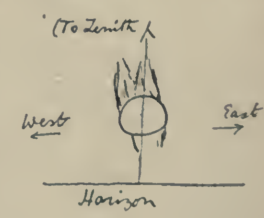
THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

H.M.S. "Encounter."
April 29,
Eclipse Day, 11.30 p.m.

THE eclipse is over, and we have only seen quite a little of it. For a long time we have been making our preparations, and for more than a week we have been drilling nearly daily. The weather has not been very kind, and either heavy showers or light rain have fallen during the day or night. However, it seemed that we might be lucky and secure a cloudless moment, or we might repeat the Palma eclipse of 1905 and be partially clouded out. Well, it has been very much worse than Palma.

The early morning of the eventful day was far more cloudy than usual, in fact, there was a great amount of cirrus cloud and numerous cumuli. As eclipse time came along, evidently the reduction of the temperature in this very humid climate (nearly always 75 per cent. or more of saturation) caused the aqueous vapour to condense into cloud, and the cloud increased and increased in amount as the time for second contact approached. So cloudy was it, and so disturbed was the air, that the observer who was watching the cusps could not be certain of giving the correct observed time of totality by them.

By chronometer time the eclipse clock was started, and the whole party went through their programme as if it were a rehearsal. The greater part of totality was hardly observed at all, and the whole of it was seen through fairly thick cirrus cloud. After the eclipse was over the clouds gradually dispersed, and long before fourth contact was reached a nearly cloudless sky was *en évidence*. The whole affair has been a great disappointment, both to the astronomers and the ship's company.



The corona was distinctly of a minimum type, the fish-tail portion of it being pointed towards the zenith (see sketch). One large prominence in the north-west quadrant was conspicuous towards the end of totality, and gave a ruddy hue to the corona in that quarter. Owing to the great amount of cloud, long extensions could not be observed, but the fish-tail portion extended, to my eye, one diameter away. Clouds prevented me from seeing any conspicuous feature on either the east or west limbs, but on the lower limb there seemed to be the indication of the stump of a large streamer.

At the time of writing, the following results have been secured, but only a few plates of some of the instruments have been developed. Steward equatorial, three plates developed, two of which may be useful. These show the lower corona only, including the stumps of some streamers. Two plates only of the De la Rue coronograph have been developed, and they are not dense, owing to the cloudy nature of the sky. One plate from the 4-inch 16-foot coronograph has been developed, and this seems very much underexposed. No plates of the large grating spectrograph have as yet been developed, but one (the only plate developed), taken with the 6-inch prismatic camera near the end of totality, shows a considerable number of lines in addition to some continuous spectrum. In fact, the photographic results so far obtained seem to be better than what was anticipated from the cloudy conditions.

One may really sum up the whole results of the expedition as a failure, considering what we might have obtained had the weather been more propitious.

Nearly all, if not all, the eclipse parties have obtained almost similar results; but it is early yet to say for certain until the plates have been developed.

W. J. S. LOCKYER.

[1] Continued from p. 499.

SCIENCE AT THE WHITE CITY.

At the Coronation Exhibition, which was recently opened at Shepherd's Bush by Prince Arthur of Connaught, a section devoted to pure science has again been included. This is the third of these science exhibitions, the first having been in the Franco-British Exhibition some three years ago. The formation of such a section at that time was suggested by the British Science Guild, and it was managed by a committee nominated by the Guild. The second science section was in connection with the Japan-British Exhibition last year, and it was larger and more comprehensive than the previous one, and was managed by a separate committee of the exhibition; and the third, which is now to be seen at the White City, is again on a still larger scale, and occupies no fewer than three large courts in what are called the "overhead buildings" leading from Shepherd's Bush Station to Wood Lane. That sections devoted to pure science are now being included as a matter of course in most of the important exhibitions is shown by the fact that the International Exhibition now open at Turin has a rather large science collection, including two laboratories actually at work.

The object of such sections is to bring together the methods and results of recent scientific research and invention in a form which will attract the notice of the general public, and will have an educative effect on all who may examine the exhibits. The results of the two previous science sections in the White City have been very satisfactory, and many men of science have been much surprised at the intelligent interest taken in the collections by the ordinary visitors to the exhibition, who must be entirely unacquainted, as a rule, with pure science and with the nature of scientific investigations.

The section in the present exhibition is divided into fourteen parts, representing the different sciences. The whole work has been under the control of a strong representative committee, and each division has been under the care and control of an expert in the particular science dealt with. All this work has been honorary, and grateful thanks are due to those gentlemen who have devoted much time and labour to the work of collecting and arranging the exhibits, while equally grateful thanks are due to the many investigators of science who have so kindly lent their apparatus and the products of their researches for exhibition. It must, however, be clearly understood that the domain of science is so wide and large that the collections merely illustrate portions of the fields of various sciences, and only such portions, indeed, that lend themselves easily to demonstration in an exhibition.

In the present exhibition an attempt is made to give parts of the collection a more living interest than had hitherto been possible by showing certain apparatus actually at work. To take, for instance, the section devoted to physical science; in this, by the courtesy of the Marconi Company, an apparatus is being installed for sending and receiving Marconi telegrams. The apparatus is that which is actually employed in sending messages to shore from a Cunard steamer, and it will be possible to send wireless messages from the end of one of the long science courts to the end of a second, and visitors to the exhibition will be able to send off and receive such wireless messages without charge.

A good many of the pieces of apparatus too in the physical science section will be actually at work, being driven by a separate electrical installation, which has been erected at considerable cost.

It is almost impossible to review all the fourteen divisions of the science section, but a few of the exhibits perhaps may be mentioned.

A large and important collection is shown under astronomy, including some excellent photographs and transparencies of star clusters and nebulæ, while M. Deslandres sends some illustrating clouds of calcium and hydrogen in the upper atmosphere of the sun. There is also a collection of sundials and astrolabes, including one belonging to Mr. Knobel, and dated so far back as A.D. 1224.

In meteorology, the Meteorological Office is well represented. In anthropology, a very complete collection of skulls (or casts of them) is shown which have been found in different parts of Europe, and which throw light upon the ancient history and evolution of mankind. Anthropometric measurements will also be made in this division. Very interesting, but rather technical, collections are shown in geology and palæontology, while in the mineralogy and crystallography section the emerald exhibited by the Duke of Devonshire is said to be the largest in the world. A very fine collection is shown under the head of chemistry, one case, dealing with the rusting of iron and the corrosion of propeller blades, being specially noticeable, while vanadium steel and ferro-silicon are also shown. The last-named compound, it may be remembered, has sometimes caused loss of life when carried on ships, and the conditions of such accidents are explained.

The London School of Tropical Medicine has also a most important and interesting exhibit dealing with such diseases as sleeping sickness, plague, &c. Under agriculture, the remarkable experiments of Prof. Percival, of Reading, on the growing of wheat are illustrated, while other exhibits deal with stone-ground flour. Models are also shown of the methods of growing crops by the help of high-tension electricity, such as would be used in a field or in a greenhouse. Under seismology, the delicate instruments used for recording earthquakes, and also Prof. Milne's tide recorder, are shown, while one seismograph has had to be erected in the Machinery Hall, as it has to rest on the ground itself, while the science attractions are housed in raised buildings. This seismograph will be at work throughout the exhibition, and will record any earth tremors or earthquakes which may happen during this time. Interesting collections are also shown under the head of geography and oceanography.

ANTHROPOLOGICAL EXPEDITION TO NEW GUINEA.

An interesting anthropological expedition to New Guinea is about to take place under the auspices of the University of Oxford as represented by the Committee for Anthropology. The sum of money required for the purpose has been made up out of considerable grants of equal amount furnished by the Common University Fund (with the condition that whatever specimens of native handiwork are procured, duplicates excepted, shall be offered as presents to the Pitt-Rivers Museum) and Balliol, Magdalen, and Brasenose Colleges, whilst smaller but still considerable contributions of varying amount have been made by University, Exeter, Lincoln, Corpus Christi Colleges, Christ Church, and Jesus College, Sir William Anson and Dr. Arthur Evans having likewise in a private capacity afforded welcome help to the expedition fund. The Committee for Anthropology has selected Mr. D. Jenness, of Balliol College, to undertake the work of exploration. Mr. Jenness holds the Oxford diploma in anthropology, and went on to Balliol as the holder of several scholarships from New Zealand, where he not only graduated with first-class honours in classics at the University, but likewise had occasion to acquire practical experience of the conditions of camp-life in the bush.

So far as can be foreseen at present, Mr. Jenness will reach Papua in November, and will take as his base of operations Bwaidoga, on Goodenough Island, one of the almost unknown D'Entrecasteaux Group, off the south-east coast of New Guinea. When Sir W. Macgregor arranged for the partition of British New Guinea amongst the various missionary societies, the islands of south-east New Guinea fell to the Methodists, and the station of Bwaidoga is one of the latest fruits of their enterprise. The Rev. A. Ballantyne, who is in charge of the D'Entrecasteaux Group, will render Mr. Jenness all the assistance in his power, and the help of all the Methodist missionaries in that region is similarly assured. Further, the Lieutenant-Governor of Papua, the Hon. J. H. P. Murray, has given his full approval to the expedition as thus arranged, and has promised it his official support.

Mr. Jenness will probably begin with a general survey of the D'Entrecasteaux Group, but as soon as he has got thoroughly into touch with the natives, hopes to be able to settle down to a detailed study of Goodenough Island

in particular. The examination of its trade relations, however, may entail a visit to the neighbouring Trobriands. If it prove possible, he will also proceed so far afield as Rossell Island, where certain ethnological problems of peculiar interest await solution.

SOME AMERICAN ORE DEPOSITS.[1]

NEW MEXICO has one of the longest mining histories of the western United States, for its semi-civilised aborigines, the Pueblo Indians, mined gold and turquoise before the arrival of the first white explorer in 1534. The Jesuit missions converted the Indians to Christianity, and then sweated them as miners until they were goaded into revolt, and the Spaniards were only readmitted on condition that their industrial operations were confined to agriculture. Mining was only resumed with the discovery of the copper-bearing sandstones at the close of the eighteenth century. Placer mining was started in 1828; the modern era of active mining was begun about 1866 upon the silver-lead ores, followed during the present century by the opening of mines of copper, lead, and zinc. The State contains large deposits of bituminous coal of Cretaceous age.

The geology of the country has a long and scattered literature. A general survey of its metalliferous mining fields was made in 1905 by Dr. W. Lindgren, Louis C. Graton, and C. H. Gordon, and a preliminary account of their results was issued as a Bulletin (No. 285) by the United States Geological Survey in 1906. The volume containing the detailed account of their researches consists of a general summary of the economic geology, followed by descriptions of the separate fields and mines. The work will no doubt remain for years the standard authority on the mines of New Mexico, and will repay study by all students of ore deposits. It contains, moreover, instructive evidence on some problems of general geology. The volume is illustrated by instructive topographic maps, mine plans, and plates; a geological map of the State, however incomplete, would have been very useful.

New Mexico has a base of Archæan crystalline rocks covered unconformably by Cambrian quartzites. The northern part of the State shows the stratigraphical gap so characteristic of the Rocky Mountain sequence, for the Cambrians are followed by the Carboniferous; but the intermediate Palæozoic systems are represented in the Southern districts. The Mesozoic series, usually complete in the Rocky Mountains, is imperfect, as the Jurassic is sparsely represented. The Carboniferous beds include marine limestones, followed by "Red Beds," some of which belong to the Trias. The Cretaceous system includes 6000 feet of marine beds; their deposition was followed by active earth movements, and the intrusion of sheets and laccolites of granodiorites which lifted the overlying Cretaceous rocks into domes. Igneous activity was renewed in the middle Cainozoic, when wide lava flows were erupted from numerous volcanic vents; at the close of the Cainozoic came a third period of igneous activity, and the outpouring of vast sheets of basalt. The last eruptions were of very recent date.

The "metal deposits," as the Monograph calls them, for the term metallisation is replacing mineralisation, though both assume similar limitations—are divided by the authors into six groups. The oldest series, the ores in the pre-Cambrian rocks, contain gold and copper, and were developed as fahlbands in shear-zones.

The second group of ores are contact-formations around the laccolites. The evidence offered by the mines as to the range of the contact metamorphism is of much interest. The shales are altered for a very narrow width, but the limestones may be completely changed for half a mile. The authors are emphatic that the metasomatic are more important than the paramorphic changes, and that the addition of silica, iron, and sulphides from without is "positively proved." The fresh materials are attributed to emanations from the intrusive magmas. The limitation of contact metamorphism "simply to a rearrangement of molecules in a single bed is absolutely contrary to the facts." That these ores were not introduced in solution after the intrusive rock had cooled is shown by the unaltered condition of its border.

The igneous rocks belong to that granodiorite- and quartz-monzonite series which is so often associated with ore deposits. The rocks are granular, although they solidified at the comparatively shallow depth of sometimes only 2000 feet. The toughness of their cover appears to have prevented their reaching the surface.

The third series of ores are veins connected with the granodiorite intrusions. They are usually pyritic gold-quartz fissure-veins. The veinstones include albite, tourmaline, and fluorite, and the ores often include much blende. They are usually normal fissure veins, one of which is illustrated by a fine coloured plate of part of the vein. Such figures are very useful. The regular trend of the veins is doubtless due to compression during the intrusion of the igneous rocks.

Ore bodies and veins due to the replacement of limestone form a fourth group. They are associated with the igneous rocks, but occur some distance from the contact. The chief ores are of silver, lead, and zinc; the two chief minerals are galena and calcite. The most famous of these deposits is the ore-body known as the Bridal-Chamber, a mass of almost pure kerargyrite found in limestone beneath a cap of andesite. The authors regard the ore as older than the andesite, and as formed above a hidden intrusion of porphyry.

The fifth group of ores are veins connected with the Cainozoic volcanic rocks. They occur in shoots where the lavas have been propylitised, and have no doubt been formed by the action of hot mineral waters at a slight depth below the surface.

In connection with these veins the authors describe an interesting fluorite vein formed in gneiss by the hot springs at Ojo Caliente. The vein contains barite, limonite, oxide of manganese, silver, and gold. The richest examples assayed contained $75 of silver and $30 of gold to the ton. The mineral waters, owing to their predominant sodium carbonate and chloride, are described as of well-defined volcanic affinities (p. 71), and they supply an interesting addition to the known mineral veins formed by existing hot springs.

The last group of minerals are copper ores, usually chalcocite, in the Red Sandstones. The ores are epigenetic, but their distribution shows no relation to that of any igneous rocks; they contain no gold and very little silver. A coloured plate of these ores includes one in which the chalcocite has replaced coal. In the San Miguel Mine tree trunks 60 feet by 2½ feet in diameter have been almost completely replaced by glance. The widespread occurrence of copper in Red Sandstones of late Palæozoic and Triassic age has given rise to considerable discussion, and is a very suggestive fact. Dr. Lindgren discusses the origin of these ores, and rejects the theories of their precipitation from solution or formation by adsorption; and he concludes that they are due to minute traces of copper, some of which may have been sedimentary, by meteoric waters containing chlorides and sulphate. Mr. Graton offers a somewhat different explanation owing to the lack of evidence of descending acid solutions. He regards the chalcocite as introduced by ascending alkaline carbonates containing metallic sulphides in solution. As in the historic case of Mansfeld, the ores in the Sandstones appears to be most abundant above the richest copper-bearing veins in the underlying rocks, a fact which is in favour of Mr. Graton's view.

Mr. E. C. Harden's bulletin on the manganese deposits gives a summary of the known manganese deposits in the United States, and brings up to date Penrose's well-known monograph. The author's personal observations were made during a tour from January to April, 1908. The information then collected is supplemented from the literature and by chapters on the manganese deposits of other countries and on the chemistry and uses of the metal. The manganese ores of the United States belong to four main series. The first includes residual peroxides left by the

[1] "The Ore Deposits of New Mexico." By W. Lindgen, C. C. Craton, and C. H. Gordon. Pp. 361.
"Manganese Ore Deposits of the United States," with sections on Foreign Deposits, Chemistry, and Uses. By E. C. Harden. Pp. 298.
"Some Ore Deposits in Maie and Milan Mine, New Hampshire." By W. H. Emmons. Pp. 62. (Washington: Government Printing Office, 1910) (U. S. Geological Survey-Bulletins 432, 427, and Professional Papers 68).

decomposition of manganiferous silicates in crystalline rocks. The second type includes bedded ores; their manganese was derived from the silicates of crystalline rocks, and was deposited in the sedimentary rocks and then concentrated; this group includes the Appalachian ores, the most important in the United States. The two last groups comprise the manganese minerals associated with the silver ores of Leadville and other western mining fields, and the deposits with the Jurassic radiolarian jasperoids of California, which, according to Prof. Lawson, were deposited by suboceanic springs.

The chapter on the protean chemistry and uses of manganese describes the introduction of manganese steel in consequence of Hadfield's discovery that though the addition of 5 per cent. of manganese renders steel brittle and useless, the presence of about 12 per cent. produces a metal so hard, tough, and nonmagnetic that it has very important industrial applications.

Maine and New Hampshire are States in which mining is of secondary importance, but Mr. W. H. Emmons' short and interesting bulletin shows that ore deposits occur which have some features in common with those in the adjacent provinces of Canada. The geology is well known from Hitchcock's memoir and the later researches of Dr. G. O. Smith. The valuable minerals include gem-bearing pegmatites, which are not described in this bulletin, and some pyritic veins and ores of lead, zinc, silver, copper, and molybdenum. The basement of the area consists of metamorphic rocks, which are regarded as probably Archean; they are succeeded by sediments and volcanic rocks attributed to the Cambrian; the volcanic rocks were followed or accompanied by some igneous intrusions, beside which ores were formed as contact deposits. These rocks were then crushed to schists, at a date which is pre-Silurian, "but how much older is not known." Granitic intrusions followed in the Devonian.

The most interesting ores are the pyritic bodies, which here, as in other cases, give clear evidence of the depth at which the rocks were foliated, for the change took place where the ores were in the zone of fracture and the slates were in the zone of flow.

The bulletin contains some excellent illustrations of the microstructure of the ores. One of the most novel is of molybdenite ore from the Catherine Hill Mine. It is given to illustrate the author's view that the molybdenite was a primary constituent of the granite, and that the felspars floated in the liquid molybdenite; whereas the photograph, showing that the sulphide is permeating the large crystal of orthoclase and that a thin felspathic tongue with a disconnected end projects into the solid ore, rather indicates the secondary nature of the molybdenite.

J. W. G.

RECENT CONTRIBUTIONS TO THE STUDY OF HEREDITY.[1]

(1) PROTOZOA have as yet played but little part in the literature of heredity, and there are even some writers who belittle and disparage the evidence afforded by this group of animals on the ground that there is in them no separation of germ-plasm from somato-plasm. On the other hand, Jennings and Bateson have pointed out the importance of following the behaviour of conjugating and dividing Protozoa, since at such phases of life the phenomena of heredity are seen in a simple form. It is now known that this simplicity is deceptive. The protozoon does not simply cleave into two daughter cells, but first of all absorbs certain organs of its body, and after dividing its substance between the two or more descendants, leaves to them the further task of reforming these lost organs and other parts afresh. Moreover, in such a way is the cleavage carried out that the regenerating parts required by each daughter cell are not optically symmetrical. One may form a "head," the other a "tail," from what was the middle of the parental body. In other words, a dividing protozoon exhibits heredity under the form of alternate symmetry.

In the first paper on our list, this form of heredity is dealt with as fission. The particular animal studied is a species of Euplotes, a genus of ciliate infusoria commonly found on Hydra. Before division takes place, a new mouth is formed, independently of the existing one, by a depression of the ectoplasm, and a modification of its substance develops into a definite peristome. Meanwhile, the meganucleus elongates and becomes segmented into definite regions. The old cirri are gradually absorbed, and are replaced in the daughter cells by new structures. The author describes these changes in great detail, and promises another contribution upon the changes in Euplotes during conjugation.

(2) The pomace-fly, Drosophila, has been the subject of much recent investigation in America owing to its short life-history and the ease with which it breeds in captivity. The present paper, by Mr. F. E. Lutz, deals with the inheritance of abnormal venation in the wings of this fly. The facts, put very briefly, are that in wild specimens a few additional veins are occasionally, but rarely, met with, and the experimental evidence shows that in a large number of matings the percentages of such abnormally veined specimens are:—normal × normal, 9·6 per cent.; abnormal ♂ × normal ♀, 35·8 per cent.; normal ♂ × abnormal ♀, 54·7 per cent.; abnormal ♂ × abnormal ♀, 85·9 per cent. Discussing these remarkable increases in the ratio of abnormal to normal offspring, the author suggests that in *all* Drosophila gametes there is a factor tending to produce additional veins, but that its effects are often obscured, and only become visible in what may be called the upper part of its range. Especially interesting is the rise in the intensity of this factor when an abnormal strain is selected for breeding, and its rise and subsequent fall in a normal strain. Another point of importance is the observation that normally veined flies select normal mates when given a choice of both kinds. Mr. Lutz also gives a most interesting appendix on the question of disuse and degeneration of wings in this fly. Drosophila is a good flier, but when bred for forty generations under conditions that preclude the use of the wings, no degeneration or diminution in these organs can be detected. Altogether this is a very laborious and careful piece of research with bearings on many problems.

(3) The next two papers deal chiefly with the ovarian tissues of mammals. Much importance has been attributed to Guthrie's experiments on the transplantation of hen's eggs to foster-mothers of a different colour from that which produced the egg. According to this writer, the offspring of such foster-birds developed from the transplanted egg and were influenced by the foster herself. Davenport has recently denied both of these results, and now we have a contribution by Prof. Castle and Mr. Phillips upon similar experiments in guinea-pigs and rabbits. The results arrived at are not a little confusing. In the clearest case the procedure was as follows. The two ovaries of an albino were removed at intervals of a week, their places being taken by an ovary from each of two black sows of differing ancestry. After recovery, the albino foster-mother was put to an albino guinea-pig. Two hundred days later two ♀♀ were born, both of which were black with red hairs, and two months later one ♂ of the same colouring. Some three months afterwards the albino died of pneumonia, and was found pregnant with three full-grown ♂♂, again black and with red hairs interspersed. One of her daughters mated with the same albino ♂ threw two albinos and one black. A control mating between a pure black ♀ and the same albino ♂ gave five young, all of which were black with red hairs.

These results are held to show that the engrafted ovarian tissue was the source of the black young produced by this cross albino × albino, and that no foster-mother influence could be detected. But, on the other hand, all the remaining cases go to show that, as in Davenport's fowls, extirpation of the ovary is not complete, and is followed by regeneration, the regenerated ovary being the source from which the young produced

[1] (1) "Euplotes Worcesteri II. Division." By L. E. Griffin. *Philippine Journal of Science*, Vol. v. No. 6, December, 1910. Pp. 322–336+5 plates.
(2) "Experiments with Drosophila Ampelophila concerning Evolution." By F. E. Lutz. Pp. iii+40. (Carnegie Institution, Washington: Publication No. 143, March, 1911.)
(3) "On Germinal Transplantation in Vertebrates." By Prof. W. E. Castle and J. C. Phillips. Pp. 26. (*Ibid.*: Publication No. 144, March, 1911.)
(4) "The Maturation of the Egg of the Mouse." By J. A. Long and E. L. Mark. Pp. iv+72+6 plates. (*Ibid.*: Publication No. 142, April, 1911.)

during the experiment are derived. A review of recent work on this difficult subject is appended to this paper.

(4) The last paper on our list deals with the egg of the mouse. By most observers the egg of this animal has been regarded as an exception to the rule that two polar bodies are formed during maturation. In order to clear up this point and to settle many other doubtful features of this egg, Prof. Mark and Mr. Long have undertaken an elaborate research involving the examination of 1000 eggs from 147 mice. The methods employed are given in welcome detail, and a special feature of the apparatus was a balance and recording drum so arranged as to indicate automatically the time of parturition. The histological results show that all mouse-eggs form two spindles and a first polar cell, and that all eggs on coming into contact with spermatozoa form a second polar cell. With regard to details, the authors conclude that the number of chromosomes is twenty. The chromosomes of the first spindle are "tetrads," and show indications of both transverse and of longitudinal fission, whilst those of the second spindle are "dyads," and divide longitudinally. The work is most carefully executed, and is fully illustrated, but the cytoplasmic structures are scarcely visible in the plates. The paper is one of great value to embryologists.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held at Philadelphia on April 20–22, and more than sixty papers on scientific and literary topics were presented.

It has been the custom for several years to devote one half-day session to a symposium on some special subject in science. This year the afternoon of April 22 was devoted to this feature, the topic being modern views of matter and electricity; and the following papers were offered:—The fundamental principles, by Prof. D. F. Comstock, of Boston; radio-activity, by Prof. B. B. Boltwood, of New Haven; thermionics, by Prof. O. W. Richardson, of Princeton; the constitution of the atom, by Prof. H. A. Wilson, of Montreal. The general conclusion seems to be that the atom of matter, groups of which compose the molecules of different substances, is built up of much smaller parts, called electrons, identical with the smallest unit of negative electricity. It was also explained how it is possible to estimate the actual number of electrons in any particular atom. As the inertia of an electron emitted from an atom of a radio-active substance, such as radium, has been experimentally proved to be a function of its speed, the evidence is strong that all inertia or mass may be electrodynamic in its nature.

Physiology.

The secretion of the adrenal glands during emotional excitement, by Prof. W. B. Cannon, Harvard University. The adrenal glands and the sympathetic nervous system are intimately related. The sympathetic system innervates the glands, and the glands in turn secrete a substance that affects bodily structures precisely as the sympathetic system affects them. The sympathetic system is aroused to activity in states of emotional excitement. Examination of the blood of excited animals reveals the presence of adrenal secretion, which was not found in the blood before the excitement. Possibly the adrenal secretion continues the excited state. Possibly also the adrenal secretion caused by emotional disturbances has some of the effects produced by injection of the substance, such as glycosuria and atheroma of arteries. Indeed, two of the author's students, Shohl and Wright, have recently shown that glycosuria can be produced in the cat by fright. The suggestion, however, must be put to further experimental test.

Coagulation of the blood, by Prof. W. H. Howell, Johns Hopkins University. The theory of the coagulation of blood most commonly accepted at the present time holds that three of the four necessary factors in the process are present in the circulating blood, but that the fourth, which initiates the process in shed blood, is furnished by the tissues outside the blood or by the disintegration of corpuscular elements in the blood itself. This fourth factor is an organic substance of the nature of a kinase, which, in conjunction with the calcium salts of the blood, serves to activate the prothrombin, also present in the blood, to thrombin. The thrombin then acts upon the fibrinogen and converts it to fibrin, which constitutes the essential phenomenon of clotting. In opposition to this theory, the author gave experimental evidence to show that in normal blood the fluidity is due to the constant presence of an antithrombin, and that in shed blood the tissue elements furnish a substance, thromboplastin, which neutralises the antithrombin, and thus allows clotting to take place. In the vertebrates below the mammals, the thromboplastin is furnished by the cells of the outside tissues, and without their cooperation clotting would not occur. In the mammals, thromboplastin is furnished by elements in the blood itself, the platetets, so that the blood may clot promptly without cooperation on the part of the outside tissues. In human beings, the condition known as hemophilia, in which there is delayed clotting and danger of fatal hæmorrhage, the defect is due, not to a lack of kinase in the tissues as a whole, the view usually taught at present, but to an excess of the antithrombin normally present in the blood.

The cyclic changes in the mammalian ovary, by Leo Loeb, director of the Pathological Department, St. Louis Skin and Cancer Hospital. In the mammalian ovary cyclic changes of a very far-reaching character take place. They concern the follicles, corpora lutea, and ova. There exists in the ovary a mechanism (in the corpus lutem) regulating those changes; the corpus lutem prolongs the sexual cycle, not by retarding the maturation of the follicles, but by preventing the rupture of the mature follicles. The author's recent observations make it very probable that a partial parthenogenetic development of some ova accompany those cyclic changes in the follicles in a certain percentage of animals.

Electrical Engineering.

The high voltage corona in air, by Prof. J. B. Whitehead, Johns Hopkins University. The author described the limitation to the long-distance electrical transmission of power imposed by the insulating properties of the air, and a new method for determining accurately a voltage at which the air in the neighbourhood of electric wires and cables will break down, and also gave the results of a series of experiments on the influence of the size of the wire, the stranding of the wire into a cable, the frequency, the pressure, the temperature, and the moisture content of the air. He also reviewed the bearing of present physical knowledge on the nature of the phenomena which are involved.

Geology.

Supposed recent subsidence of the Atlantic coast, by Prof. D. W. Johnson, Harvard University. The author briefly reviewed the evidence in support of the generally accepted theory that the Atlantic coast is subsiding at the rate of from 1 to 2 feet per century, and showed that the phenomena supposed to indicate subsidence might be produced by fluctuations in the height of ordinary high tides resulting from changes in the form of the shore-line. A study of the Atlantic shore-line indicates that conditions are there favourable to marked local changes in the height of the tides, independently of any general movement of the land. On the other hand, the structure of certain beaches along the coast afford very strong proof that there can have been no long-continued progressive subsidence of the coast within the last few thousand years. The theory of fluctuating tidal heights, and the theory of stability of the land mass, were illustrated by selected examples of shore-line phenomena.

Alimentation of existing continental glaciers, by Prof. W. H. Hobbs, University of Michigan, Ann Arbor. It was in the Alps of Switzerland that the early studies, and by far the larger number of subsequent investigations, of glaciers have been made. The Swiss type of glacier is one of the most diminutive, but as the theory of former continental glaciation was derived from these studies of puny glaciers, it is not surprising that their attributes were carried over unchanged to the reconstructed extinct types thousands, and even tens of thousands, of times larger,

and this before any continental glaciers had actually been studied. The recent explorations of Norwegian, German, Swedish, and Danish explorers, but more than all of Peary in Greenland, and of Scott, Nordenskiöld, von Drygalski and others, but especially of Shackleton in Antarctica, have at last afforded us observations upon the existing continental glaciers. When these reports are carefully studied and compared, it is found that, as regards their form, their erosional processes, and especially their nourishment and waste, continental glaciers are as different as possible from those of the Alpine type. Instead of being nourished by snow precipitated from *surface* air currents, which are forced to *rise*, their snow supply is derived from the fine ice grains contained in *high-level* cirrus clouds which have been *drawn down* to the glacier surface, been melted, and there reprecipitated. This action is the work of a refrigerating air engine, which is developed directly by the snow-ice mass itself.

Front range of the Rocky Mountains in Colorado, by Prof. W. M. Davis, Harvard University. The front range of the Rocky Mountains in Colorado, now easily accessible by various railroad lines which enter and cross it from Denver and Colorado Springs, is an unusually fine example of a mountain highland, which in a former cycle of erosion was reduced to moderate relief, and since elevation to its present altitude has been submaturely dissected by its streams. The highland is surmounted by numerous hills and mountains of from 500 to 2500 feet relief, which represent the unconsumed residuals of the former cycle of erosion, and therefore presumably consist of the most resistant rocks of the region. The uplift of the mountain belt to its present altitude was not perfectly uniform, but arched gently from the plains westward; thus the crest of the range seems to correspond to the crest of the arched uplift. A notable feaure of the higher valley heads, among the surmounting mountains near the range crest, is the occurrence of numerous amphitheatres or cirques, and over-deepened valley troughs, the work of glaciers which for a moderate time, as geological time is reckoned, replaced the water streams in the highest districts. The contrast between forms due to ordinary or normal erosional processes and to glacial erosion is thus displayed with unusual clearness.

Astronomy.

An important astrophysical paper was presented on the solar constants of radiation, by Mr. C. G. Abbot, director of the Astrophysical Observatory, Smithsonian Institution, Washington. If we had no eyes we should still know of the sun by the feeling of warmth. The most exact measurements of the intensity of the rays of the sun, whether they be visible to the eye or affect the photographic plate or not, are made by an electrical thermometer called the bolometer. This instrument is so sensitive that a millionth part of a degree change of temperature is recorded by it. For seven years the bolometer has been used by the staff of the Astrophysical Observatory of the Smithsonian Institution to measure the solar constant of radiation. This constant represents the number of degrees (centigrade) which 1 gram of water would rise in temperature if all the solar radiation which could pass through an opening 1 centimetre square outside the earth's atmosphere, but at the earth's mean distance from the sun, could be used for one minute to heat the water. As all life, and almost all forces on the earth, depend on the supply of solar rays, the solar constant of radiation is at least equal in importance to the knowledge of the sun's distance.

The value of the solar constant was unknown within wide limits only five years ago. It is now believed to be within 1 per cent. of 1·93 calories per square centimetre per minute. Measurements made at Washington (sea-level), Mount Wilson (1 mile elevation), and Mount Whitney (nearly 3 miles elevation) agree in fixing this conclusion.

Nearly 500 determinations have been made. They indicate that the value is not really a "constant," but fluctuates about the mean just given within a range of 8 per cent. This conclusion means that the sun is a variable star. It is hoped soon to verify it completely, and it may prove for meteorology hardly less important than the determination of the mean value of the solar constant itself.

On the evening of April 21 Prof. Arrhenius, of Stockholm, gave an illustrated lecture on the physical conditions of the planet Mars. He directed attention to the many similarities between Mars and the earth which have caused some to think that Mars is inhabited, but gave it as his opinion that later investigations are not favourable to this view.

At the executive session on Saturday, April 22, the following new members were elected:—*Residents of the United States:* Dr. G. A. Barton, Bryn Mawr, Pa.; Dr. B. B. Boltwood, New Haven, Conn.; Dr. Lewis Boss, Albany, N.Y.; Dr. J. M. Clarke, Albany, N.Y.; Dr. W. M. Late Coplin, Philadelphia; Dr. J. Dewey, New York City; Dr. L. O. Howard, Washington, D.C.; Dr. J. P. Iddings, Chicago; Mr. Alba B. Johnson, Rosemont, Pa.; Dr. A. A. Noyes, Boston; Dr. G. H. Parker, Cambridge, Mass.; Mr. A. Lawrence Rotch, Boston; Dr. L. S. Rowe, Philadelphia; Dr. William T. Sedgwick, Brookline, Mass.; and Dr. A. Trowbridge, Princeton, N.J. *Foreign residents:* Prof. Svante Auguste Arrhenius, Stockholm; Prof. J. B. E. Bornet, Paris; and Sir John Murray, K.C.B., F.R.S., Edinburgh.

As has been customary, the meetings ended with a banquet at the Bellevue, Stratford, on Saturday evening, at which the following toasts were responded to:—"The Memory of Franklin," by President Schurman, of Cornell; "Our Universities," by Count von Bernstorff and President Hadley, of Yale; "Our Sister Societies," by Sir John Murray and Prof. W. M. Davis, of Harvard; and "The American Philosophical Society," by Prof. E. C. Pickering, of Harvard. Thus ended one of the most successful meetings in the history of the society.

ARTHUR W. GOODSPEED.

PHOTOGRAPHY AN AID TO ASTRONOMY.[1]

IN my address last year I endeavoured to put before you some of the problems which confronted the astronomer, and to illustrate the reasons why the most refined methods of physical measurement available were necessary in order to secure data for the solution of such problems. To-day I propose to deal rather with the methods in use, and the progress which has been, and is being, made in securing the necessary data for discussion, and in particular to sketch to you the advances which have been rendered possible through the introduction of photography as an aid. In these days, when portable hand cameras are accessible to everyone, when photographs can be taken by the mere expedient of pressing a button, leaving the manufacturers who supply the material to "do all the rest" at a trifling cost, or when even the processes of development can be performed by an inexperienced operator without the aid of any more elaborate equipment than a supply of fresh water, one is apt to forget how recent is the development of photography, not merely as a science or art in itself, but still more as a useful adjunct to almost every other branch of scientific investigation.

To appreciate the use of photography, try to imagine, if you can, a state of existence deprived of the sense of sight, not only in the individual, but throughout the human race. The phenomenon of light could doubtless still exist, and even be capable of exerting certain physiological action, but this phenomenon is one with which we are primarily cognisant through the direct physiological action on the optical nerves, and without which the intercourse of the individual with the external world is, perhaps, limited by the further senses of "sound," "touch," "smell," and "taste." All these senses, even including the first, are brought into operation only by closely adjacent surroundings, whereas the additional sense of sight, apart from its use as a means of communication between individuals, is the sole remaining sense by which we can obtain information regarding unexplored and otherwise inaccessible regions. I venture to doubt whether, under such conditions, the human intellect would have

[1] Presidential address delivered before the Royal Society of South Africa on April 19, by Mr. S. S. Hough, F.R.S.

risen to such primary conceptions as that of a "point" and a "line," let alone a "straight line," and whether even the most primitive of the sciences—that of geometry—could have originated, though, perhaps, a sense of geometrical form might have been developed through the touch. Be that as it may, however, it is perhaps not too much to say that our knowledge of the extra-terrestrial universe has at least until recently been derived solely through the medium of those æthereal vibrations which we call light, to which our eyes respond, thus communicating with the brain, and though this physical phenomenon might conceivably have existed apart from the existence of human or other eyes, its existence could scarcely have been recognised, and the science of astronomy, which deals primarily with extra-terrestrial phenomena, could hardly have been. Thus it is that the development of this science has been largely concurrent with the development of those instruments by which the optical efficiency of the eye has been increased. The earliest observations were made with the unaided eye, the results of which have come down to us, being duly recorded either in the form of descriptions or drawings, or even, in some cases, by more or less exact measurements. The introduction of the telescope not only immediately opened up fields of vision previously inaccessible, but facilitated in a very marked degree the precision with which measurements could be made, and for about three centuries the telescope has been used as a direct aid to the visual organ. It is improbable that this method of observation will ever be superseded, but there is to-day a growing tendency to replace the human eye at the end of the telescope by the photographic camera.

The advantages of the method are two-fold:—(1) objects which are too faint to be seen with the eye may yet be photographed by a sufficient extension of the time of exposure, and our powers of penetrating the confines of space is thereby increased; (2) the photographs themselves form a permanent record of what is seen more trustworthy than can be obtained from any drawing or description executed at the hands of man. The early application of the art of photography to astronomy related to the subject from its descriptive aspect rather than to those branches of the science which depend on exact measurement. With the aid of reflecting telescopes of large aperture, it was found possible to delineate with certainty the forms of vast nebulæ, so as to establish with great nicety the extension of their convolutions into regions where to the eye alone their traces were quite invisible, even with the aid of powerful telescopes. But, fascinating as these photographs are in aspect, valuable as they are as early records, and suggestive as they are with regard to the cosmical significance of the objects photographed, it can scarcely be maintained that they have so far been prolific in scientific results. Such phenomena as the wonderful spiral forms assumed by many of the nebulæ, though proved to be far more common than was previously realised, remain as obscure as ever in their origin. In making this statement, I do not wish to underrate the work of the earlier pioneers in astronomical photography. They have developed methods which we continue to use, and have but little to improve on, and they are not to be blamed if the full value of their work has not been attained in their own generation. Visual work had already been carried so far that the extended vision afforded by photography could hardly have been expected to lead instantaneously to any new and startling phenomenon which should revolutionise existing ideas of the extra-terrestrial universe. It is only as time lapses, and we are able to study the changes which are taking place since these photographs were secured—changes which, as a rule, take place so exceedingly slowly as not yet to be fully established—that the full advantage of the new method over the old will be realised.

The earliest attempts at the photography of celestial objects seems to date back so far as the year 1840, when photographs of the moon were obtained by daguerreotype processes, but beyond its use for pictorial representation—to which, perhaps, I might add the daily photographic record of the sun's surface, instituted at Greenwich in 1873, the unsuccessful attempts by Pritchard at the instigation of Warren de la Rue to utilise it for the determination of the constant of nutation—for a long time it seems to have been regarded with suspicion for purposes requiring the use of exact measurements. While photography might supplant the astronomical draughtsman, its limitations were in other respects similar to those affecting the draughtsman's art and skill. The latter aspects of its uses are those which I propose chiefly to deal with tonight, not that I wish to underrate the importance of other applications, but that I prefer rather to confine myself to those branches with which I have myself been more directly concerned. The year 1882 saw the first introduction of astronomical photography into the Cape Observatory. No special appliances for the purposes were at the time included in its equipment, but the unexpected appearance of the great comet of that year demanded that an effort should be made to secure a representation of this comet by photographic methods, which had been vigorously developed elsewhere for such purposes. Accordingly, the services of a local photographer were secured, and in order to obtain a sufficiently long exposure to bring out the faint detail of the comet's tail, his camera was attached to one of the equatorial telescopes of the observatory, so that it might partake of the motion imparted to the telescope, and thus be kept pointed on the comet for a prolonged interval. Valuable photographs showing much detail of the structure of the comet were obtained, but the feature to which particular attention was directed was the large number of stars, some of them extremely faint, which, besides the comet, were all duly recorded on the plate. Moreover, the sharpness of the photographic images suggested that they would permit of very accurate measurement, and that, if only similar definition could be obtained in photographs on a more open scale, it might be possible to replace many of the laborious methods of measurement hitherto conducted by direct visual observations on the sky itself by somewhat similar methods applied to the photographs.

There existed at the time no comprehensive survey of the southern skies. A complete catalogue of the stars in the northern heavens, known as the Bonn "Durchmusterung," giving the positions and magnitude of all stars down to the ninth visual magnitude, with a precision at least accurate enough to ensure their identification in the sky, had been formed by Argelander, and extended to a portion of the southern hemisphere by his successor, Schönfeld, but the remainder of the heavens from 23° S. declination to the South Pole was still comparatively unknown. The photographs I have above referred to suggested a means by which this lacuna might be filled, and no sooner was this idea conceived by Sir David Gill than steps were taken to put it into active execution. Partly at his own personal expense, and partly by means of assistance from the Government Grant Fund, administered by the Royal Society of London, the necessary equipment and the services of a photographer were secured, and between the years 1885–9 a complete series of photographs of the region extending from 18° S. declination to the South Pole was obtained. In order, however, that these photographs might be of value to science, it was necessary that the facts duly recorded on them should be minutely examined and rendered accessible to astronomers generally, in the form of a catalogue. As more than 400,000 stars were involved, this in itself was no light task, and might well give rise to the question as to whether the necessary measurements could not be more advantageously made on the sky rather than on the photographic plates by which it was represented. The method which was subsequently adopted for the formation of this catalogue forms sufficient answer to this question. The resources of the observatory were unequal to so large an undertaking, at least without the cessation of a large proportion of its normal work, and it appeared probable that the photographs would have to remain in the record room of the observatory, valuable for consultation regarding specific points which might arise, but that their complete discussion would have to be relegated to a perhaps remote future. The difficulty was at this juncture met by a generous offer received from Prof. Kapteyn, of Gröningen. Prof. Kapteyn was himself an enthusiastic astronomer, eagerly desirous of devoting himself to work of this character, with full appreciation of its value, but unfortunately unprovided with an observatory equipment. He foresaw that, with the aid of a comparatively small laboratory equipment,

much of the work of a character which had hitherto been performed by reference to the sky could be effectively and rapidly carried out through the medium of photographic representations thereof. The series of photographs secured at the Cape formed a promising field for research, and he voluntarily undertook the laborious task of the measurement of these plates and the preparation of a catalogue, which has since been issued among the publications of the Cape Observatory, and to-day is in constant use by astronomers concerned with the southern hemisphere. Besides many incidental results of high interest, the catalogue forms the basis for statistical investigations of stellar distribution, &c.

The success of the project, even in the early stages of its execution, pointed to the possibilities of a still more extended use of the photographic methods, and gave a direct stimulus to the study of the details by which its efficiency could be increased. The surveys of Argelander and Schönfeld, completed by the "Cape Photographic Durchmusterung" (as the above catalogue is entitled), and independently by a visual "Durchmusterung" emanating from the observatory at Cordoba, under the direction of Dr. Thome, could but be regarded as preliminary pioneer surveys; but, stupendous as the task seemed, the possibility was recognised by Sir David Gill of utilising the photographic method for the production of a complete map of the heavens, which should be on a sufficiently large scale and sufficiently precise in its detail to meet all the requirements of modern astronomy of precision. He succeeded in securing the interest of astronomers generally, and in particular of Admiral Mouchez, the then director of the Paris Observatory, at whose instance, with the support of the Paris Academy of Sciences, an international conference of astronomers was invited to meet in Paris in 1887 to discuss the possibility and desirability of carrying out this extended project. While the plan in outline met with universal acceptance, much useful discussion took place at this and at subsequent conferences as to the details of its execution, such as the type of instrument to be employed, the scale of the photographs, the duration of exposure which would serve to bring out what should be considered essential detail, &c. The outcome was that an agreement was arrived at by which the execution of the work was partitioned among eighteen cooperating observatories, who between them undertook to secure photographs of the whole sky with instruments of similar dimensions and design, and, so far as possible, similar conditions of exposure. Two series of photographs were to be taken, one of long exposure, designed for direct photographic reproduction to form an atlas which should show all stars down to the fourteenth visual magnitude, and a second series, of shorter length of exposure, designed for exact measurement, which would form the basis of a catalogue of precision of all stars to the eleventh magnitude. Minor details were largely left to the discretion of the directors of the cooperating observatories.

It would take too long to describe in detail the progress of this work from its initiation, and I propose, therefore, to confine my attention to the share in it which has been taken by the observatory over which I have the honour to preside, a share which, partly from the origin of the project and partly from the scarcity of suitably situated observatories of a sufficiently permanent character in the southern hemisphere able to offer cooperation, has exceeded that assigned to any other single establishment. The type of instrument agreed upon was the photographic refractor, similar in dimensions to that which has been used by the Brothers Henry in Paris, giving pictures on such a scale that 1 millimetre on the plate corresponds with a minute of arc on the sky. The plates were to be 160 mm. square, so as, apart from the marginal edges, to yield an effective field of views of two degrees square. The area covered by each plate will perhaps be better presented to you by the statement that the length of the edge of the plate corresponds, roughly, with four times the apparent diameter of the sun or moon, *i.e.* four suns and four moons photographed side by side on the same plate would just reach from one edge of the plate to the other. On this scale it would require rather more than 10,000 plates to cover the whole sky. The programme, however, provided not merely for the photographing of each region once, and once only, but that the various regions covered by the separate photographs should overlap in such a way that every star would be contained in two of the regions at least. Thus any doubtful features shown in one plate could be verified by reference to the second plate, which includes the same area. This requirement raised the total number of separate regions to be photographed to 22,054, of which 1512 were assigned to the Cape Observatory. The construction of the telescope and the provision of suitable housing accommodation was sanctioned in 1888, and the telescope arrived at the Cape in 1890. About two years were spent in its erection, adjustment, and testing, the delay being largely due to the necessity for returning the object-glass for necessary alterations and the remodelling of the breech-piece, which could not be effected locally. From July, 1902, onward, the work of taking the photographs was steadily proceeded with until its completion in 1910. At the present time we have stored at the Cape three almost complete series of photographs of the 1512 regions, besides many duplicates and triplicates, which, though not attaining the desired standard of perfection, are still available for reference with regard to many issues that arise. Of these plates, one series of long exposure is destined for direct photographic reproduction; the other two series of shorter duration of exposure for measurement for the purposes of the catalogue. On account of the comparatively insignificant amount of work involved in taking these catalogue plates as compared with the more laborious work of measurement, after its original completion in 1896 it was decided to repeat the whole series of catalogue plates, so as to bring the dates of the photographs nearer to the epoch 1900, and thereby more fully attain the ideal before the International Conference of leaving for a future generation as exact a record as possible of the appearance of the heavens at the beginning of the twentieth century.

After some early experiments with the view of ascertaining the most economical means by which these plates might be measured with the desired accuracy, the definitive programme of measurement was commenced in 1897, and completed last year. The number of stars measured on a plate varies between 45 and 3431, the total number of star images which have been measured exceeding a million. To illustrate the precision attained, the discordances in the position of a star, relatively to the stars immediately surrounding it, as derived independently from the measures made on two overlapping plates, but rarely amount to so much as a second of arc, *i.e.* apparent angular distance between the two edges of a halfpenny at a distance of about three miles from the observer. Now, however exactly the measurable features of each plate may be determined, it will be clear that the information thus derived can be of little value without some external data to enable the identification of the region on the photograph with the corresponding region of the sky from which it is derived. A plan of this room might have been useful to enable you to find your seats to-night in positions corresponding to the numbers on your tickets, but I venture to think a stranger visiting Cape Town for the first time would prefer to have been provided with a map of the town, which would indicate the position of this hall, rather than to have to search the town for a room arranged according to such a plan. So with our photographs, the detailed study of each photograph can be of minor value without some indications enabling us to identify the field shown on the photograph, not only in relation to the surrounding fields, but in relation to the sky as a whole. It is certainly a desideratum that these indications should be not less precise than those involved in the measures themselves. Of course, if each photograph contained some familiar group of stars, such, for instance, as the constellation Orion, the identity of the region could not be easily mistaken; but the scale of which the plates are taken is such that two such familiar stars are rarely to be found within the limits of a single plate, while many plates are devoid of stars to which accurate positions could have been previously assigned.

The necessity has thus arisen of determining with high accuracy the absolute positions as opposed to the relative positions indicated by the plate itself, or at least two stars contained on each plate. The distance between the

images of these stars as compared with the corresponding apparent distance on the sky serves to furnish a determination of the scale of the plate, while the direction of the line joining them serves to fix the orientation of the plate, *i.e.* enables us to turn the plate round in its own plane, so that the true N. and S. line may be placed exactly in a truly horizontal, truly vertical, or, in fact, any other desired direction. With these quantities correctly assigned, either star will be sufficient to correlate the plate exactly with the sky. In practice it is customary to refer to a larger number of stars than two on each plate. Not only are the determination of these necessary "plate constants" strengthened thereby, but in the consistency with which the photographic pictures reproduce the actual distribution of the stars, we have a valuable check on our methods and a test of the faithfulness with which also other features on the sky are represented on the photographs. For the Cape plates, the determination of the "plate constants," *i.e.* of those elements which serve, as it were, for the coordination of the isolated maps contained on each plate with a general map of the whole, has been made to depend on a number of stars on each plate varying, as a rule, between 8 and 12. In all, 8560 stars, so far as possible evenly distributed over the whole of the zone, were selected as comparison stars. These stars constitute a framework to which the detailed results derived from the photographs may be attached, but the structure of which requires to be independently built up. For such a purpose, photographic methods have not as yet proved available, and recourse was necessary to the older method of visual observing with the meridian circle. From observations made in the years 1897–1900 with the transit circle an accurate catalogue of these 8560 stars has now been formed, and has been utilised for the purpose of standardising each of our plates. The heavy arithmetical work involved in applying to each of our original measures more than two millions in number, the derived correction to refer the whole to a common standard is now rapidly proceeding, and at the present time is about half completed.

I have above referred to the catalogue of 8560 comparison stars as framework for the support of the more extensive photographic catalogue. Such a framework, at least on the basis on which the one was constructed, is not entirely self-supporting, and it thus behoves us to carefully consider its foundations and to ensure that they possess the necessary solidarity. Not the least of the important questions brought up for discussion at the last meeting of the International Committee charged with the conduct of the photographic work was that of the steps to be taken for this purpose. It was recognised on all sides that even the best existing meridian catalogues were inadequate, and that they would have to be supplemented by extensive additional observations. The main object of the discussion was to secure the most extensive cooperation from observatories provided with suitable meridian equipment, and to classify the work in various grades of accuracy, so that each establishment might devote itself primarily to that branch for which its equipment was best adapted, at the same time keeping in view the coordination of its work with the larger scheme. The resolutions adopted have since been favourably received by meridian observers, and we may look in the future to a systematic organisation of meridian astronomy throughout the world, the results of which, apart from the mere economic aspect, cannot fail to be of the highest importance to science. It may well be asked, What is the use of such a chart as you have been describing? or, Will it repay the enormous cost involved in compiling it? As regards its use, I endeavoured to indicate in my address last year some of the problems which awaited solution, and which serve to inspire the astronomer in conduct of the lengthy routine operations involved. These motives are, perhaps, for the most part scientific and intellectual rather than utilitarian, and it is possible, even probable, that to many of the questions arising answers which will afford complete satisfaction will not be forthcoming at least for a generation or two to come. I think I am sufficiently voicing the view of those who took part in the original discussions at Paris when I state that they, as a body, attached greater importance to the complete and thorough systematic record of the phenomena prevailing during their own generation than to the immediate interpretation of these phenomena. It was felt to be a scientific duty, incumbent on them to provide, so far as lay within their means and capacity, data which should be beyond reproach. By this means they were preparing the ground and planting the seed, which they hoped would yield a rich crop of scientific results, even though it should remain for their children's children to reap the harvest.

Much has already been attained. The ghosts which beset the use of photography in relation to the science of exact measurement have in a large measure been laid, and photographic methods have now been successfully used for some of the most delicate measurements ever attempted even by direct visual operation. I have in mind such questions as the determination of the distance of annual parallaxes of the fixed stars, and of the parallax of the sun, in connection with which, under the auspices of the Paris conference, an extensive photographic campaign, combined with visual methods, was undertaken on the occasion of the near approach of the planet Eros in the years 1900–1. The discovery of the latter planet was itself a product of photography, while by similar means the number of known minor planets has within the last few years increased by leaps and bounds, until at the present day they are nearly seven hundred in number. Photography has also been prolific in the discovery of variable stars and new stars, and the tracing of their light changes. All these purposes will be greatly facilitated by the existence of a trustworthy chart or catalogue containing more especially the fainter stars about which our exact knowledge hitherto has been almost non-existent. Time must elapse before we may expect to be able to evaluate with any certainty the slow changes of position due to the proper motion, at least, in relation to the previously uncatalogued faint stars; but this is to-day one of the greatest desiderata for the advancement of our knowledge of the universe, and is one of the purposes for which the photographic catalogue was primarily intended. By photographic methods and by cooperative effort throughout the world alone has it been possible to collect evidence on a sufficiently wholesale scale, so that already we are beginning to feel the solution of some of the most profound problems relating to the universe almost within our grasp.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows in presenting for the degree of Doctor in Science, *honoris causa*, (1) Dr. G. E. Hale, director of the Solar Observatory on Mount Wilson, California, and (2) Prof. T. W. Richards, professor of chemistry in Harvard University:—

(1) Adest vir in republica maxima transmarina caeli in orbibus observandis iam per annos plurimos maximo cum fructu exercitatus, qui Californiae sub caelo sereno, montis Wilsonii in vertice excelso, instrumentis novis adhibitis, solis ipsius materiem exquisivit et stellarum remotissimarum mutationes investigavit. Rerum caelestium auguri tam perspicaci stellarum ipsas origines nebularum (ut aiunt) formae obscurae illustrant; stellae autem colore primum candido, deinde flavo, denique rubro coruscantes, orbium illorum vitam per seriem exorientem, maturescentem, deficientem indicant; orbis denique terrarum noster quasi imago stellae est ex qua lumen calorque iam dudum evanuerunt. Newtoni nostri in Opticis dicitur in montibus summis, supra nubes densiores, in aëre maxime sereno et tranquillo, stellas melius posse observari:[1] gratulamur auguri nostro caelesti quod Californiae in monte altissimo arcem nactus est, caelo observando tam opportunam, unde orbis terrarum incolis vallium et camporum in obscuritate degentibus rerum naturae lucem ipsam possit desuper transmittere. Viro tot titulis aliunde cumulato, etiam nostram coronam libenter donamus.

Duco ad vos astronomum insignem, Georgium Ellery Hale.

(2) Filiam suam, aequore Atlantico a se divisam, studiorum communium amore coniunctam, mater alma

[1] Newton's "Optics," Book I., part i., *ad finem*.

Cantabrigiensis non sine superbia quadam contemplatur. Ergo matris almae nomine scientiae chemicae professorem Harvardianum non sine gaudio salutamus, virum et inter suos et inter Germanos doctrinae in sedibus sex praeclaris educatum. Quod si Latino potissimum in sermone de meritis eius vultis admoneri, videor mihi "propter egestatem linguae et rerum novitatem"[1] rem admodum difficilem ingredi. Peritis tamen comprobavit, sese, in rerum elementis fere quindecim, atomorum pondera ipsum comperisse, atque discipulis suis primordiorum tam minutorum subtilissime examinandorum exemplum praetulisse viamque ostendisse. Idem primus indicavit, elementi cuiusque in atomo quo minor vis insit, eo artius elementum illud comprimi posse. Idem etiam metallorum in provincia, computationibus usus accuratissimis, Faradii legem quandam praeclare confirmavit. Academiae nostrae, scientiarum accuratarum cultrici tam assiduae, pro certo novimus rerum exploratorem tam accuratum perquam esse cordi.

Duco ad vos scientiae chemicae professorem accuratissimum, Theodorum Willelmum Richards.

The general board of studies has reappointed the following university lecturers from October 1, 1911, until September 30, 1916, and the appointments have been confirmed by the special boards with which they are connected:—Botany, A. G. Tansley; mathematics, H. W. Richmond and R. A. Herman; pathology, Dr. Cobbett.

Dr. James, Provost of King's College, has been nominated to represent the University at Rennes on the occasion of the inauguration, in October, of new university buildings and of a monument commemorative of the union of Brittany with France.

The board of managers gives notice that an Arnold Gerstenberg studentship will be offered for competition in the Michaelmas term of 1912. The competition will be open to men and women who have obtained honours in part i. or part ii. of the natural sciences tripos, and whose first term of residence was not earlier than the Michaelmas term of 1906.

GLASGOW.—Captain Lyons, F.R.S., has announced his resignation of the University lectureship in geography, on his removal to London to take up his duties at the Royal Geographical Society. He has succeeded in establishing a flourishing department at the University, where geography is now recognised as a subject for the M.A. and for the B.Sc. degree. The University Court will proceed to make an appointment to the office during the summer.

Prof. R. A. Stewart Macalister, of Dublin, has been appointed Dalrymple lecturer in archæology for the ensuing academical year.

A scheme for the affiliation to the University of the Glasgow and West of Scotland Technical College has received the approval of the Scottish Universities Committee of the Privy Council. Ordinances for the purpose of carrying the scheme into effect and admitting the students of the college to university privileges and degrees will now be framed and laid before Parliament in due course.

The Royal Infirmary of Glasgow has received a new charter, which, *inter alia*, provides for the representation of the Court and Senate of the University on its board of management. From the University side an ordinance has been promoted, and now awaits the approval of his Majesty in Council, which establishes four new professorships at the Royal Infirmary, namely, in medicine, surgery, obstetrics, and pathology. The existing (regius) chairs in these subjects continue to be connected with the Western Infirmary. Both institutions, which between them contain about 1200 beds and well-equipped extern departments, will thus have equal rank as the clinical schools of the University. All the instruction provided at the Royal Infirmary will be open to women students of the University on the same terms as to men. A new clinical laboratory for study and research has been erected at the Western, to which a director will presently be appointed. A pathological institute on a large scale, including a clinical laboratory, is approaching completion at the Royal; and by the gift of an anonymous benefactor, a similar building is in progress at the Victoria Infirmary, which will also be available for university students. The medical school of Glasgow is becoming one of the best equipped in the country, especially as regards its provision for scientific teaching and investigation.

[1] Lucretius, i. 139.

OXFORD.—On Tuesday, June 13, another stage was reached in the discussion of the proposed statute exempting students of natural science and mathematics from compulsory Greek. An amendment prohibiting exempted candidates from offering themselves in any other final honour school except these two was carried by 93 to 36. A further amendment, moved by the Master of Balliol, which sought to limit the exemption to candidates who should obtain certain qualifications before entering the University, was rejected by 105 to 39. The statute as amended will now be submitted to Congregation, and if it passes will come before Convocation for final decision.

Prof. John Milne, F.R.S., has been appointed Halley lecturer for 1912.

WE learn from *Science* that Mr. T. C. Du Pont has given 100,000*l.* to the Massachusetts Institute of Technology toward its proposed new site. Announcement is also made of two bequests of about this amount. A trust fund of between 100,000*l.* and 120,000*l.*, created by Mr. Francis B. Greene some five years ago, will be received by the institute for the assistance of students, and it will receive nearly 100,000*l.* from the bequest of Mrs. Emma Rogers, widow of the first president of the institute. These large gifts, in addition to the 20,000*l.* for ten years voted by the State, will make it possible for the institute to purchase a new site and erect the necessary buildings. From the same source we learn that, by the will of Mrs. Lydia A. Barnard, of Milton, Mass., Radcliffe College receives 23,000*l.* and Harvard University 12,000*l.*

THE fourteenth annual Conference of the National Head Teachers' Association was held in Manchester last week. The association adopted a resolution to the effect that no exemption should be allowed from school attendance until the age of fourteen has been reached; that there be compulsory attendance at continuation schools from the age of fourteen to seventeen; that a well-devised scheme of physical development of young people should form part of the curriculum of every continuation school; that it be the statutory duty of every local education authority to make suitable provision for the carrying on of such continuation schools in its area as may be necessary; that the Government provide suitable grants for this purpose; and that it should be the statutory duty of employers of young persons under seventeen to enable them to attend continuation classes at such hours as may be required by the Act.

THE Department of Agriculture and Technical Instruction for Ireland would appear to have adopted the view that geography is a science, and should be taught as such in schools. For the session 1911–12 a course of physical and commercial geography will form one of the subjects of experimental science which may be taken up in Irish intermediate schools. Anticipating the difficulty which principals of schools may experience in finding teachers competent to deal with geography in a scientific manner, the Department is arranging for a summer course of instruction in the subject, to be held, from July 4 to 28, at the Royal College of Science, Dublin, for teachers who have already qualified themselves in elementary experimental science. The Department has circulated an outline syllabus in physical and commercial geography suitable for pupils in their third and fourth years. The work for the former year includes a practical study of the geography of the home district; the figure, motions, and position of the earth; the atmosphere; the land; and the general geography of Ireland. The fourth year's work comprises the physical geography of the sea and a course of commercial geography of a general kind.

THE second volume of the report of the U.S. Commissioner of Education for the year which ended on June 30, 1910, is now available. The 746 pages are devoted almost exclusively to statistics, which supplement in an admirable manner the descriptive articles in the previous volume, already noticed in these columns.

During the year under review, the Bureau of Education at Washington received reports from 602 universities, colleges, and technological schools in the United States. Of these, 142 are for men only and 352 for both sexes. The entire teaching force of these 602 institutions of higher education numbered 27,279. The aggregate enrolment of students reached 301,818, including students in all departments—preparatory, collegiate, graduate, and professional. The aggregate of gifts and bequests reported by the 602 institutions for the year 1909–10 was 3,747,430*l*. Of this amount, 1,228,700*l*. was given for buildings and improvements, 1,954,200*l*. for endowment, and the remainder for current expenses. The largest amounts were received by the following institutions:—Columbia University New York, 409,000*l*.; Yale University, Connecticut, 403,000*l*.; Princeton University, New Jersey, 342,000*l*.; University of California, 248,000*l*.; University of Chicago, Illinois, 239,000*l*.; and Bryn Mawr College, Pennsylvania, 142,000*l*. Twenty-seven institutions altogether each received 20,000*l*. or more during the year.

THE report for the year 1910 of the council to the members of the City and Guilds of London Institute is now available. During the year a petition was made to the King for a supplemental charter to enable the institute to cooperate more effectively with other bodies in the coordination of technological work, more especially in the metropolis, and on December 16, 1910, the supplemental charter was granted, and its provisions are printed in the report. The Imperial College of Science and Technology has obtained from the Commissioners of the Exhibition of 1851 a grant of a large piece of land at South Kensington, on part of which a building is being erected which will eventually be added to the Central Technical College, and will with that college form the engineering section of the Imperial College. The enlarged college, towards the cost of which the Goldsmiths' Company has made a grant of 50,000*l*., will be known as "The City and Guilds College" (Engineering), thus perpetuating the connection of the institute with the engineering work in London. Among other matters, it may be noted that the course in railway engineering for post-graduate and other duly qualified students, organised by the college in 1908–9 in connection with the Imperial College of Science and Technology, has been continued and considerably enlarged. Reports are included also of the year's work at the City and Guilds Technical College, Finsbury, the South London School of Technical Art, and the Department of Technology.

IN a suggestive article on "Scientific *versus* Personal Distribution of College Credits" (*Popular Science Monthly* for April), President William T. Foster, of Reed College, Portland, Oregon, directs attention to the want of a uniform standard in the classification of students in different subjects in American universities and colleges, but his criticisms are equally applicable to similar institutions on this side of the Atlantic. Adopting the system of grading students in five classes, of which four represent a pass and the fifth represents failure, the author tabulates for several colleges the percentages of students receiving the several grades in different departments, and the numbers show very large discrepancies. Thus in Harvard College in one year the percentage of students in the highest grade varied from 1 per cent. in English to 35 in Greek; in the second grade from 11 per cent. in English to 33 per cent. in fine arts, and so forth. The result of these discrepancies is that the poorer students seek the courses which give the larger proportions of high grades. The author points out that to all students who are prompted by unworthy motives his charts indicate the easiest way to a degree; moreover, it is useless to suppress such information, as students in all colleges are guided by such charts more or less accurately plotted. In the University of Missouri, on the other hand, a system has been introduced of equalising for different departments the percentages of students placed in the several classes, with the result that "we come nearer to knowing what a grade stands for at the University of Missouri than at any other institution in the country." For this purpose a normal distribution is adopted in which 25 per cent. of the students are in the first two classes, 50 per cent. in the middle class, and 25 per cent. in the fourth and fifth. The author suggests that instructors should be required to tabulate the actual distribution of grades in their departments each year, and that all marked divergences from the normal distribution should be made the subject of a special report.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society June 1.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. R. **Kennedy**: Experiments on the restoration of paralysed muscles by means of nerve anastomosis. This communication is the first of three series of experiments on restoration of paralysed muscles by means of nerve anastomosis. The present series consists of ten experiments on monkeys and dogs, in which, after division of the facial nerve, the peripheral segment of the latter was attached to a neighbouring nerve. Sometimes the hypoglossal and sometimes the spinal accessory was the substitute. The experiments also varied in mode of uniting the nerves, and in interval of time elapsing between section of the facial and union with the substitute. Among the conclusions are the following:—Where spinal accessory or hypoglossal is substituted for facial nerve, restoration of voluntary co-ordinated movements of facial muscles is possible. Restoration commences sooner when the hypoglossal is used, although the ultimate results, so far as recovery of facial movements is concerned, do not appear to show much difference. On the other hand, the new paralysis produced temporarily or permanently in the distribution of the substitute nerve is more serious when the hypoglossal is employed. Where association movements are present in consequence of the anastomosis, these are more objectionable when the hypoglossal is used. As regards interval of time between section of the facial and performance of anastomosis, there is no decided difference in date of commencing recovery between immediate anastomosis and a secondary anastomosis after the lapse of one month. An addendum gives a report, twelve years after operation, of a case of spino-facial anastomosis published in Phil. Trans., 1901; also of a case of facial paralysis of three years' standing in which spino-facial anastomosis was done, and in which recovery commenced three years subsequently.—Sir David **Bruce**: The morphology of *Trypanosoma evansi* (Steel). In previous papers published in the Proceedings the morphology of various trypanosomes, such as *Trypanosoma pecorum*, *vivax*, *uniforme*, *nanum*, and *brucei*, has been described somewhat more fully than is usually done. It is proposed to do the same for *T. evansi* in this paper. This trypanosome causes the disease in elephants, camels, horses, cattle, and dogs known in India as surra. It was discovered in 1880 by Evans in the Punjab. It is curious that in India this is the only pathogenic trypanosome of the domestic animals which has up to the present been described. In Africa many species are known—in fact, here may be said to be the home of the trypanosome diseases. In Africa these diseases are associated with tsetse-flies. In India there are no tsetse-flies. The carrier of surra has not yet been identified. It is generally thought that surra has been introduced into Africa by means of the camel, but this is by no means established. Up to the present it has been usual to look upon the trypanosomes of surra and nagana as indistinguishable morphologically. In this paper 820 individuals of *T. evansi* have been carefully measured, and a curve representing the distribution in respect to length made. This curve is very different from that of *T. brucei*. It is therefore evident there should be no difficulty in future in separating these two species by this means. Again, on comparing the curve of the Indian camel disease with that of the African, the similarity is very striking, and affords some proof that the two diseases are caused by the same species of trypanosome.—H. S. **Stannus** and Dr. W. **Yorke**: The pathogenic agent in a case of human trypanosomiasis in Nyasaland. During the past three years a considerable number of cases of human trypanosomiasis have occurred in Nyasaland, notwith-

standing the fact that *Glossina palpalis* has not, as yet, been discovered in the Protectorate. The authors have examined the trypanosome obtained from the blood of a European infected in the Dowa sub-district of Nyasaland. The parasite was also examined in the blood of a monkey, rabbit, and goat infected from the patient. Morphologically the trypanosome was found to present the same peculiarity as was observed in the case of a trypanosome from a patient infected in the Luangwa Valley of north-east Rhodesia. This peculiarity consisted in the fact that amongst the short forms some have the nucleus at the posterior (non-flagellar) extremity. In a condition of heavy infection these posterior nuclear trypanosomes form from 2 to 5 per cent. of the total parasites present. A second interesting point in the morphology of this parasite is that the cytoplasma was frequently found to be vacuolated in a remarkable manner. Whether or not this is a constant feature we are unable to state from the small amount of material at our disposal. A monkey, rabbit, or goat inoculated with the parasite became infected, and in all the disease ran an acute course. As a result of their observations, the authors are of opinion that the trypanosome in question is not *T. gambiense*. On the other hand, it very closely resembles *T. rhodesiense*, and is probably identical with it. The disease was contracted in a district (Dowa sub-district of Angoniland) where *G. palpalis* has never been found, but where *G. morsitans* is known to exist in large numbers. It appears probable, therefore, that this trypanosome (*T. rhodesiense*) is a distinct species, capable of transmission by some other agent than *G. palpalis*, probably *G. morsitans*.—Captain R. **McCarrison**: The experimental transmission of goitre from man to animals.—Dr. Helen **Chambers** and Dr. S. **Russ**: The action of radium radiations upon some of the main constituents of normal blood. Experiments have been performed *in vitro* with the following results:—When blood is mixed with radium emanation hæmolysis occurs with gradual conversion of oxyhæmoglobin into met-hæmoglobin. The hæmolysis is a gradual process, and has been found to occur as a direct result of α radiation. Leucocytes show marked degenerative changes when exposed to α rays. During the process of clothing leucocytes appear to move away from a region radiated by α rays. This motion is not due to a direct action of the rays on the leucocytes, but has been attributed to changes found to occur in the surface tension of blood serum when radiated. The specific properties of opsonin and hæmolytic complement are lost when serum is exposed to α rays. The progressive changes caused by these rays indicate the separate identity of opsonin and complement. The β and γ rays have yielded negative results in analogous experiments.—F. L. **Usher** and J. H. **Priestley**: The mechanism of carbon assimilation.—Part iii. Details are given of further experiments supporting conclusions arrived at in parts i. and ii. of this series, as to the primary products of photolytic reduction of aqueous solution of carbon dioxide. By the use of other sources of energy, viz. (1) α and β rays from radium emanation and its products, and (2) the radiation from a quartz mercury vapour lamp, solutions of carbon dioxide have been decomposed with formation of small quantities of formaldehyde and hydrogen peroxide. The hydrogen peroxide formed was identified by the titanium sulphate reaction; the formaldehyde by Schryver's reaction. Further experiments with chlorophyll films are described, leading to the conclusion that bleaching of chlorophyll in sunlight, whether carbon dioxide is present or not, is due to formation of hydrogen peroxide; but the production of formaldehyde in such condition and quantities as to be recognisable by the use of Schiff's reagent seemed only to occur when carbon dioxide was present. Evolution of oxygen from green tissues in which the catalase has not been killed, and from gelatin films containing catalase over which a film of chlorophyll has been spread and exposed to light in an atmosphere containing carbon dioxide, has been established by further experiments. Qualitative tests for emission of oxygen have been made by methods involving the utilisation of Beijerinck's photo-bacteria; quantitative tests by the use of apparatus enabling very small quantities of oxygen to be measured. Further evidence that some of the energy supplied to a film of chlorophyll by sunlight is used in the photolytic reduction of carbon dioxide has been obtained by an experimental proof that such film in sunlight, in presence of carbon dioxide, is at a lower temperature than a similar film also in sunlight, but in air free from carbon dioxide. The paper concludes with brief replies to some criticisms upon the experimental evidence and conclusions recorded in parts i. and ii. of this series of papers.—T. **Goodey**: A contribution to our knowledge of the protozoa of the soil. The paper is an account of work carried out on the soil protozoa which are considered to be chiefly instrumental in limiting the activity of bacteria in the soil, and thus in helping to render the soil comparatively infertile. Methods of obtaining protozoa in cultures of soil are described, and a list of the different species found so far is given. An experimental method for quickly finding the earliest ciliated protozoa occurring in a soil culture is described, in which use is made of the galvanotactic response which many of the protozoa show when stimulated by means of a continuous electric current. By means of this method, active ciliated protozoa have been found in from 1½ hours to 4 hours. Experiments on the length of time required for a ciliated protozoon, *Colpoda cucullus*, to develop from its resting cysts have also been conducted in similar media and at the same temperature as used in the soil cultures. It has been found that the times required for development in both soil and cyst cultures are comparable, and that the first *C. cucullus* to occur in soil cultures are almost identical in appearance with those which emerge from resting cysts. The conclusion drawn from the experiments is that the ciliated protozoa are only present in the soil in the encysted condition, and do not, therefore, function as the factor limiting bacterial activity in the soil.—G. **Stead**: The anode and kathode spectra of various gases and vapours.

Geological Society, May 10.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. E. J. **Garwood**: The Lower Carboniferous succession in the north-west of England. The area dealt with includes Westmorland north and west of the Dent Fault, North Lancashire to the north of the Lune Valley, and the northern corner of Yorkshire. The value of the zonal indices selected is discussed and their distribution described. Whereas the zonal indices chosen for the larger groups of beds are often sporadically distributed in the zone, the bands form remarkably trustworthy horizons, extending over large areas. In no one district is a complete development of all the zones observed, and only by taking a broad survey of the whole area can the detailed faunal sequence be established. In the Shap area the *Michelinia megastoma* zone is scarcely represented, while farther west the fauna of this horizon is one of the richest in the whole of the north-western province. The changes in the fauna of certain zones often depend more on the lithological characters of the rocks than on the introduction of new forms at definite horizons. The deposits are shown to be, for the most part, of shallow-water origin. The lowest deposits are characterised by highly magnesian limestones. The majority of the limestones throughout the series are rich in foraminifera, and the more shaly layers in ostracods and bryozoa. Both silicification and dolomitisation of the limestones were practically contemporaneous with the deposits in which they occur. The movements which have affected the rocks in the Arnside district have been the result of nearly horizontal thrusts, and it is shown by means of zoning that the beds have in places been inverted, and are dipping at more than 120°. The palæontological divisions are correlated with their probable equivalents in the Bristol area. Several new species of corals and one new genus are described, and the affinities of several corals and brachiopods are discussed.—Prof. S. H. **Reynolds** and Dr. A. **Vaughan**: The faunal and lithological sequence in the Carboniferous limestone (Avonian) of Burrington Combe, Somerset. Lithology.—The series is almost continuously calcareous from the base of Z to D_1, where the section ends; the K beds are, to a large extent, shales. Crinoids are the prevalent limestone-builders throughout K, Z, and C_1; in C_1 the rock is of the crinoidal type, known as *petit granit* by the Belgian geologists. A band of oolite occurs in the upper part of K_1. C_2 and

S_2 are very largely oolitic, conspicuous white oolite prevailing at the top of C_2. There is much oolite in the upper part of S_2. An important point is the prominent part played by foraminifera, which are the principal limestone-builders in C_2, S_1, and much of S_2. In the upper part of S_2, peculiar concretionary limestones, showing imperfect "Cotham-Marble" structure, occur. The Burrington section agrees with the other sections in showing dolomitisation in the upper C_1 beds.

Linnean Society, June 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. W. A. **Herdman**: The recent occurrence (April) of the minute dinoflagellate *Amphidinium operculatum*, Clap. and Lachm., at Port Erin in the Isle of Man, in such profusion as to discolour the sand between tide-marks in patches extending on some days for many yards. *A. operculatum* has been recorded from several places on the coasts of Europe and America, but has apparently not been previously found in Britain.—Dr. A. Smith **Woodward**: The fauna of the Carboniferous period, so far as it has been discovered in the same deposits as the Carboniferous flora. The fauna agrees with the flora in consisting, for the most part, of highly specialised representatives of the lower groups, but is singularly modern in some respects. Some of the freshwater and land Mollusca are scarcely distinguishable from genera still existing. All the crustaceans are of primitive groups, and some of the most interesting are related to Anaspides, which still survives in Tasmania. The myriapods, scorpions, and spiders are similar to those of later date, but a few of the scorpions retain obvious remnants of the characters of their aquatic ancestors. Limuloids also occur. Insects are numerous, but all belong to the lower groups in which there is no complete metamorphosis, and there are many generalised types which can scarcely be referred to existing orders. Cockroaches are numerous, but have transparent fore-wings. Primitive dragon-flies occur, and some of these are the largest known insects, with a span of wings measuring 2 feet. Among fishes, the spiny acanthodian sharks, which are typically Lower Palæozoic, are still found in the Carboniferous fauna, and are known to have been preyed upon by the higher fishes. The pleuracanth sharks are characteristic of the period, and interesting as showing a more generalised vertebrate skeleton than any later fishes. The cochliodont sharks with grinding teeth appear to be closely related to the existing Cestracion, but have many of the teeth fused into extensive plates. Some of the sharp-toothed sharks also seem to have had their teeth fused into rigid masses. The highest fishes are the palæoniscids and platysomids, which exhibit all the fundamental characters of the present-day sturgeons, obscured beneath a normal covering of ganoid head-plates and scales. Large dipnoan fishes are numerous, and differ little from Ceratodus, except in showing traces of the separate points of which their dental plates are composed. Most important are the crossopterygian fishes, of which Rhizodus and Megalichthys are typical genera. These fishes make a closer approach to the earliest lung-breathers than any fishes which have existed before or since. Lung-breathers were certainly in existence just before the beginning of the Carboniferous period, and all seem to belong to a very primitive group of Amphibia, variously termed Stegocephalia or Labyrinthodontia in allusion to the complete roofing of their cheeks by bone and to the complicated structure of their teeth. In their possession of supra-temporal plates and often of post-temporal bones, as also in the marking of their superficial bones by the course of the slime-canals, these amphibians more closely resemble fishes than any later members of the order. Towards the end of the Carboniferous period some of the smaller Stegocephalia, the so-called Microsauria, seem to have passed into true reptiles very similar to the surviving Sphenodon or Hatteria.

Mathematical Society, June 8.—Dr. H. F. Baker, president, and temporarily Mr. J. E. Campbell, vice-president, in the chair.—Dr. H. F. **Baker**: The roots of multiple θ functions.—G. H. **Hardy**: The multiplication of Dirichlet's series.—G. H. **Hardy** and J. E. **Littlewood**: The range of Borel's method of summation of series.—Dr. W. H. **Young**: The convergence of Fourier series and of the allied series.—W. M. **Page**: Some two-dimensional problems in electrostatics and hydrodynamics.—Prof. W. **Burnside**: The determination of all groups of rational linear substitutions of finite order which contain the symmetric group in the variables.—Dr. W. H. **Young**: The nature of the successions formed by the coefficients of a Fourier series.—Lieut.-Colonel A. **Cunningham**: Note on Mersenne's numbers.—Prof. A. E. H. **Love** and Dr. T. J. I'A. **Bromwich**: The conditions that a homogeneous strain may be reducible to a plane strain and an extension at right angles to the plane.

CAMBRIDGE.

Philosophical Society, May 22.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Prof. **Pope** and J. **Read**: Attempts to resolve asymmetric nitrogen compounds of low molecular weight.—Dr. **Fenton** and W. A. R. **Wilks**: "Aldehydo-glyceric" acid. All of the eleven possible direct oxidation products of glycerol are now known with the exception of tartronic dialdehyde, hydroxypyruvic aldehyde, and one other. The latter is either hydroxypyruvic acid or tartronic semi-aldehyde (aldehydo-glyceric acid). One of these is Wills's acid, which is obtained from nitro-cellulose by the action of alkalis, but, owing to the contradictory evidence of different observers, its constitution still remains uncertain. An acid having the same composition, but different properties, is formed by the oxidation of glyceric acid in presence of iron, and probably by the initial decomposition of dihydroxymaleic acid. The present authors have now succeeded in isolating this acid, and are making experiments with the view of establishing its constitution.—S. **Ruhemann**: Triketohydrindene hydrate.—J. E. **Purvis, McHattie,** and **Fisher**: The non-nitrification of sewage in sea water. Systematic chemical and bacterial investigations on the decomposition of sewage in sea water have been described in researches previously published. The results proved that sewage undergoes slow decomposition in sea water, and the primary cause appears to be the rapid destruction of the nitrifying organisms. To meet the criticism that the method of incubation partially eliminated the oxygen necessary for the growth of the nitrifying organisms, the authors have passed dry air, and containing no CO_2, through various mixtures of sewage and sea water for more than seven weeks. The mixtures were examined from time to time for the two ammonias and for nitrites and nitrates. Neither nitrites nor nitrates were found at any time, and the total ammonia was only slightly decreased. The results confirm the earlier researches, and that even when abundant oxygen is there no nitrification occurs in sewage when mixed with sea water.—H. O. **Jones** and C. S. **Robinson**: Complex thio-oxalates. Salts of nickel, cobalt, iron, and palladium form complexes with salts of dithio-oxalic acid, which show intense colours even in dilute solution. Several salts of nickelo-dithio-oxalic acid, $Ni(CSO)_4H_2$, with metals and organic bases, have been isolated, and also several salts of the corresponding palladio acid, $Pd(CSO)_4H_2$. The salts of the cobalt acid with metals and with organic bases correspond to the formula $Co(CSO)_6H_3$ for cobalti-dithio-oxalic acid.—J. A. **Crowther**: (1) Further experiments on scattered Röntgen radiation; (2) the energy of the scattered Röntgen radiation from different radiators. Experiments have been made to determine the relative amounts of Röntgen radiation scattered by equal masses of different substances. It has been found that the amount so scattered is not independent of the nature of the radiator, but increases with the atomic weight.—R. **Whiddington**: The production of characteristic Röntgen radiations.—A. Ll. **Hughes**: The velocities of the electrons produced by ultra-violet light.—F. **Horton**: (1) The origin of spectra; (2) the positive ionisation produced by phosphates when heated.

PARIS.

Academy of Sciences, June 6.—M. Armand Gautier in the chair.—H. **Deslandres**: Complementary remarks on the weak magnetic fields of the solar atmosphere.—Émile **Picard**: A general theorem on integral equations of the third species.—A. **Laveran**: The unhealthiness of Corsica and the possibilities of improvement. The author emphasises the necessity of the methodical destruction of

mosquitoes, mechanical protection against their bites, and the systematic use of quinine.—Pierre **Termier** and Jean **Boussac**: The mylonites of the Savone region.—M. **de Forcrand**: The fluorhydrates of the alkaline fluorides. All the alkali metals form salts of the type MF.HF, some thermochemical data of which are given.—Ch. **Lallemand**: The changes of level of the soil in Provence resulting from the earthquake of June 11, 1907. A re-survey of the district showed that the changes of level were very slight, not exceeding 4 cm. in the neighbourhood of the epicentre.—Louis **Maneng**: Elements of the orbit of a new small planet.—Maurice **Gevrey**: The solutions of certain partial differential equations.—S. **Lattès**: The reduced forms of point transformations with two variables. Application to a remarkable class of Taylor's series.—Jean **Perrin** and Niels **Bjerrum**: Molecular agitation in viscous liquids. For liquids the viscosity of which is 100 times that of water the laws of perfect gases are applicable.—André **Blondel**: A new method of hydro-telegraphy.—F. **Croze**: The second spectrum of hydrogen in the extreme red. The lines photographed, after three hours' exposure, included wave-lengths from λ 8000 to λ 6836. No well-defined regularity in the distribution of the lines could be detected.—M. **Chanoz**: The physical development of a radiographic image after fixing with sodium hyposulphate and prolonged washing of the exposed sensitive plate.—L. **Brüninghaus**: Stokes's law and a general relation between absorption and phosphorescence.—Jacques **Duclaux** and Mme. E. **Wollman**: The osmotic pressure of colloids.—L. C. **Maillard**: The action of colloidal sulphur upon sulphide metabolism. Contribution to the study of sulpho-conjugation.—H. **Colin** and A. **Sénéchal**: The catalytic action of ferric sulphocyamide. The oxidation of phenols by ferric sulphocyanide in presence of hydrogen peroxide is due only in part to the specific catalytic action of the iron; the formation of persulphuric acid by oxidation of the sulphocyanide group also has an important bearing on the reaction.—A. **Berg**: The chromotellurates.—Marcel **Delépine**: The pyridinopentachloroiridates.—A. **Dufour**: Some new types of iridoxalic acids and complex iridoxalates.—F. **Bodroux**: The action of acid chlorides, of acid anhydrides, and of acetones on the monosodium derivative of benzyl cyanide.—M. **Hanriot** and A. **Kling**: The action of ammonia on the chloraloses.—Ernst **Zerner**: Some ethyl derivatives of acetone.—G. **Darzens**: The action of thionyl chloride in presence of a tertiary base on some esters of hydroxyacids. Ethyl lactate treated with thionyl chloride in presence of pyridine gives a good yield of ethyl α-chloropropionate. The method has been also applied to ethyl malate.—A. **Arnaud** and V. **Hasenfratz**: The oxidation of the higher acetylenic fatty acids.—Henry **Hubert**: The microlitic rocks of the loop of the Niger.—L. **Blaringhem**: The function of traumatisms in the production of hereditary anomalies in plants. A reply to some recent criticisms by P. Becquerel.—M. **Gerber**: The diastases of the latex of *Broussonetia papyrifera*. This latex contains three active ferments. Of these, the proteolytic ferment is remarkable for its resistance to high temperatures and to the action of poisonous ferments.—A. **Chevalier**: An attempt at a botanical, forest, and pastoral map of French Western Africa.—Eugène **Pittard**: Castration in man and the resulting modifications in size of different parts of the body.—Jules **Amar**: Observations on the yield and evaluation of mechanical work in man.—Pierre **Achalme**: Viscosity and diastatic actions. Hypothesis on the nature of diastases.—M. **Mazé**: Researches on the formation of nitrous acids in the living cell. Up to the present, the cholera comma bacillus is the only micro-organism capable of producing nitrous acid in organic media deprived of nitrates. The author has succeeded in isolating some species possessing the same property from plant juices. It has been proved that atmospheric nitrogen does not take part in this operation.—C. **Alliaud** and F. **Vles**: The electrocution of fish and hydrostatic stability. Specimens of Labrus, Crenilabrus, Gobius, and Motella temporarily paralysed by electric shock, showed that the centre of gravity was above the centre of hydrostatic pressure, and it is only by a constant muscular effort that the animal retains its normal position. These results confirm the views put forward by Dunoyer in 1866.—Henri **Bierry**, Victor **Henri**, and Albert **Ranc**: The action of ultra-violet light on saccharose. Under the action of the rays from a quartz mercury lamp, cane sugar is first partially hydrolysed, and the hexoses thus formed undergo a further change, resulting in the formation of formaldehyde and finally carbon monoxide.—Charles **Nicolle**, E. **Conseil**, and A. **Conor**: Experimental typhoid in the guinea-pig.—P. and N. **Bonnet**: A cretaceous layer in the valley of Nakhitchevan (Charour-Daralagoz, Transcaucasia).

DIARY OF SOCIETIES.

THURSDAY, June 15.

Royal Society, at 4.30.—Croonian Lecture: A New Conception of the Glomerular Activity: Prof. T. G. Brodie, F.R.S.—On the Action of Senecio Alkaloids and the Causation of Hepatic Cirrhosis in Cattle. Preliminary Note: Prof. A. R. Cushny, F.R.S.—Note on Developmental Forms of *T. brucei* (*pecaudi*) in the Internal Organs, Axillary Glands, and Bone-marrow of the Gerbil: G. Buchanan.—A Preliminary Note on the Extrusion of Granules by Trypanosomes: Capt. W. B. Fry.

Linnean Society, at 8.—The Anatomy of *Enhalus acoroides*, Rich.: Miss H. M. Cunnington.—On the Life-history of *Croce filipennis*, Westw.: Prof. A. D. Imms.—Eight Papers relating to the Fauna of the Seychelles: (1) Cynipidæ; (2) Proctotrupoidea: Prof. J. J. Kieffer.—Apo'dea: Prof. T. D. A. Cockerell.—Lepidoptera: J. C. F. Fryer.—Wasps: G. Meade-Waldo.—(1) Borboridæ; (2) Phoridæ: J. E. Collin.—Culicidæ: F. V. Theobald.

Royal Geographical Society, at 5.—Research Meeting. Report on River Investigation: Dr. A. Strahan.

CONTENTS.

THURSDAY, JUNE 22, 1911.

PROBLEMS OF POTABLE WATER.

Modern Methods of Water Purification. By J. Don and J. Chisholm. Pp. xvi+368. (London: Edward Arnold, 1911.) Price 15*s*. net.

WHEN Mr. Don read his paper on "The Filtration and Purification of Water for Public Supply" before the Institute of Mechanical Engineers in January, 1909, it was generally thought that a very useful addition had been made to the literature on this subject, and in following this up with the volume under review, which is in effect an amplification of the former publication, the authors have done a great service to those whose duty it is to provide a pure and efficient supply of water for domestic purposes.

Following a general introduction, the first chapter deals with the sources of supply. The possible pollutions that may be expected are fully discussed, and some most useful information is given of the best means of detecting, and, as far as may be, preventing them.

Obviously, all water destined for domestic purposes cannot be taken from sources unimpeachable, both as to purity and constancy of supply, and the next two chapters in the book deal with the first steps towards remedying these evils under the general heading of "Storage."

The main inference that is to be drawn from this section is that, in addition to ensuring constant and adequate supply from sources which depend largely on the rainfall over a limited catchment area, storage undoubtedly has a very marked effect in purifying and rendering harmless an otherwise polluted and dangerous water. The work of numerous investigators is quoted in support of this contention, particularly the valuable researches of Dr. Houston on the storage of water from the rivers Thames and Lea, published in his reports as Director of Water Examination to the Metropolitan Water Board.

The result of these researches are very lucidly summed up by the authors in the following sentences:—

"1. The microbes of disease, and those which are indicative of sewage (*B. coli*) perish rapidly in stored water. In about three weeks, generally speaking, the safety change is complete, and the dangers imminent from sewage pollution minimised.

"2. After being impounded for two or three weeks the water is in a better state from a chemical point of view, seeing that there is a well marked decrease of ordinary ammonia, oxygen consumed, oxidised nitrogen, lime salts, and occasionally of albuminoid nitrogen.

"3. Storage deprives the raw water of nearly all its sediment, and therefore serves to prolong the life of the filter beds."

There is one danger, however, occurring sometimes after prolonged storage, which should not be lost sight of; that is the abnormal development in the reservoir of algæ and other minute vegetable growths at certain seasons of the year. These growths not only cause great inconvenience by rapidly choking the filter beds, but certain species give rise to exceedingly unpleasant odours and tastes in the water, which cannot usually be got rid of by filtration. A remedy for these evils, however, is suggested in the book, namely, the addition of exceedingly small doses of copper sulphate, which, it is stated, not only will cause the death of myriads of these organisms, but if added in anticipation of a rapid development will prevent the growth taking place. The use of hypochlorites is also recommended.

Following on this exhaustive and extremely valuable discussion of *storage*, the authors devote a large section to the question of *filtration*. There are three chapters devoted to this subject, entitled respectively, "Sand Filtration," "The Management of Sand Filters," and "Mechanical Filters."

Under the first heading elaborate and exceedingly interesting and instructive explanations are given of the theory of sand filtration, which bring out very conclusively the precautions which are necessary to ensure efficient purification. The action of a sand filter appears to be threefold; first, the mechanical straining of the grosser suspended matter, this causes a film or skin composed of silt, algæ, and bacteria to form on the surface of the sand; secondly, the living algæ in this skin seem to have a power of consuming the bacteria which come within their orbit, thus retaining many of the minute organisms which would otherwise pass through the interstices between the sand grains. The third action is brought about by the slimy or gelatinous film which forms round the grains of sand in the lower layers of the bed; this has the power not only of retaining most of those microbes and minute particles of matter which escape the filmy skin, but also by a process of adsorption, of acting on the organic matter *dissolved* in the water, "mineralising" it, and converting it into innocuous nitrates, sulphates, and carbonic acid.

It is pointed out that to ensure all these actions taking place properly it is necessary that the rate of filtration should be slow (about 4 inches per hour) and uniform, as an irregular flow causes disturbance to the microbes adhering to the slimy coating of the sand grains.

All the operations in connection with the management of filters are dealt with under this heading, and details are given of their construction. Descriptions are given of many of the elaborate processes employed in different parts of the world, and the chapter concludes with a discussion on the use of coagulants for the rapid sedimentation of matter in suspension, and also for the formation of an artificial filtering skin. This leads up to an important chapter on mechanical filters, which are rapidly gaining favour in various parts of the world. Numerous appliances are described, differing chiefly in matters of detail. The general features are the use of a much greater head of water or of artificial pressure, and the use of an artificial skin produced by the addition of alum, and, if necessary, lime or some other alkali, if the water has not sufficient natural alkalinity to precipitate the alumina. The filtering medium employed

consists of sand or crushed quartz, and in some cases layers of some such oxidising material as polarite or oxidium are used, in addition to sand, as in the Candy filter.

The advantages of this method of filtration seem to be the much more rapid rate at which the water can be passed through the filters, and consequently the much smaller area which they occupy, and the ease and rapidity with which they can be cleaned by mechanical means. This effects a great saving of labour, and also does away with the workmen coming in contact with the filtering medium. As regards efficiency, it would appear that these filters are at least as efficient as ordinary sand filters.

After two very useful chapters on "The Purification of Water by Ozone" and "Water Softening and Household Appliances," two chapters follow on the testing of water. They consist of a discussion of the bacteriological, chemical, and microscopic examination of the raw and filtered waters and the inferences to be drawn from them.

The bacteriological tests suggested, and the methods of applying them are, however, somewhat open to criticism, and need revision in subsequent editions, and the suggestion that these tests should be undertaken by the water managers themselves (unless specially qualified) is also perhaps not of the happiest. To anyone acquainted with the bacteriological and chemical analysis of water, it will be apparent that unless these tests are carried out by skilled operators errors of execution and judgment are likely to crop up. The growing necessity of dealing with impure and polluted sources of supply renders frequent and careful analysis imperative, and the example of the Metropolitan Water Board and some of the Continental and American water undertakers in appointing a staff of qualified analysts might well be followed by other bodies.

As the authors point out, the interpretation of the results of analysis depend largely on local conditions, yet they give a table of the standards of purity required in Britain and America, which, by the way, are not applicable to a very large number of water supplies, and they do not state from what source these standards, in so far as they apply to British supplies, are obtained.

In the remaining chapters, the book deals with problems of distribution, and, in addition to engineering problems, several pages are devoted to the development of such growths as crenothrix in the mains and the action of peaty waters on lead. This latter subject was exhaustively investigated by Dr. Houston about fifteen years ago, on behalf of the Local Government Board, and the authors quote extensively from his work; the two kinds of action, plumbosolvency and erosion, although attributed to different causes, are frequently caused by the same water.

The authors have surely misunderstood Dr. Houston's work when they state (on p. 324) that erosion, which results in the formation of the hydroxide of lead, has probably no consequences obnoxious to the consumer, for they go on to say that the hydroxide scales away and mixes with the current. The section concludes with a general discussion on public health in relation to water supply, and an account is given of several outbreaks of cholera and typhoid fever, which have been attributed to that cause. It should have been pointed out, however, that in the case of the epidemics at Belfast, mentioned on p. 348, the water supply was completely exonerated by the Health Commission appointed to inquire into the matter.

The arrangement of the book is exceedingly good, the type clear, and the numerous diagrams and photographs make the descriptions of the various appliances very easy to understand. As appendices there are some useful tables of filtration constants and other engineering data, and a concise and well-arranged bibliography of works on water purification.

DENISON B. BYLES.

GERMAN AND FRENCH BOOKS ON CRYSTALLOGRAPHY.

(1) *Lehrbuch der Kristallphysik (mit Ausschluss der Kristalloptik).* By Prof. W. Voigt. Pp. xxiv+964. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 30 marks.

(2) *Leçons de Cristallographie.* By G. Friedel. Pp. v+310. (Paris: A. Hermann et Fils, 1911.) Price 10 francs.

(3) *Die Kristallgruppen nebst ihren Beziehungen zu den Raumgittern.* By Prof. E. Sommerfeldt. Pp. vii+79 (Dresden: T. Steinkopff, 1911.) Price 3 marks.

(1) THIS treatise is based upon the lectures delivered for some years past by Prof. Voigt at the University of Göttingen, and it concentrates also into a single volume of 964 pages the original work in physical crystallography other than optical contributed in numerous memoirs during the course of a long and active career. Prof. Voigt's name is, perhaps, most familiar from his work on the elasticity of crystals and their piezo- and pyro-electrical properties. These branches of physical crystallography are well represented in the book before us, and the only criticisms that suggest themselves are that Prof. Voigt has not given us more experimental details and illustrations of the interesting forms of apparatus employed in the researches, and that British work in this branch of science, especially the thermal expansion and elasticity of crystals, is not referred to. The result of these omissions is that in the first place the book presents a somewhat forbiddingly mathematical aspect, the theoretical and mathematical side vastly predominating and entirely overshadowing the practical experimental side of the subject, and that in the second place a certain narrowness of outlook is inevitable.

Having said so much, however, and remembering that Prof. Voigt's chair is that of theoretical physics, the thorough manner in which the subject is dealt with inside these somewhat narrow lines cannot fail to impress the reader. The most valuable consideration is, moreover, that we have here brought together for us the facts and theories for which hitherto investigators and students have had to search through the numerous original papers of Prof. Voigt. The

specialised portion of the book is preceded by an admirable review of the morphology of crystals and the structure theories of Bravais, Wiener, Sohncke, von Fedorow, and Schönflies (again we notice the omission of a British name, that of Barlow). Such a review is of special value, as it gives us the considered opinion of one who regards crystals essentially from the physical and mechanical point of view, and whose original investigations have brought him more than usually in touch with the phenomena dependent on the internal molecular and atomic arrangement of crystals. The influence of such an experience and of the character of this field of research is evident in a most interesting manner throughout. As Prof. Voigt so truly says:—

"Die besonderer Bedeutung welche die Krystallform für den Aufbau der Krystallphysik besitzt, liegt darin, dass dieselbe eine einfachste und anschaulichste physikalische Wirkung der Konstitution der Substanz darstellt."

The specialised portion of the book deals with pyro-electricity, pyro-magnetism, thermal dilatation, electrical and thermal conduction, thermo-electricity, dielectric influence, ferromagnetism, elasticity and internal friction, piezo-electricity and piezo-magnetism, and the effect upon them of change of temperature, all being considered specially with reference to crystals, as organised and perfect solids. The ground covered is thus very wide, and the practical investigator is most grateful to Prof. Voigt for placing within easy reach the theory and mathematics of all these branches of the subject. If only a few more practical hints as to the mode of carrying out the experiments, and more and better illustrations of the apparatus could have been given, the work would have been well-nigh perfect.

(2) This book does not profess to be a complete treatise on crystallography, but embodies the earlier lectures of the course in mineralogy given for some years by the author at the Ecole Nationale des Mines at Saint-Etienne, of which he is the director. Crystallography is considered first of all as the necessary introduction to the study of mineralogy by students training for mining engineers, and is therefore limited to those properties of crystals which are useful for the identification of mineral species. Hence, many of the less apparent physical properties of crystals are passed over, and those which are considered are dealt with from this limited point of view rather than for their own intrinsic interest. Indeed the author almost apologises for the necessity of treating even cursorily the fundamentally important optical properties of crystals.

The above will have sufficiently indicated the severe limitations of the book, and the narrow aspect from which it is presented. Crystallography has suffered, perhaps more than any other science, in the past from such limitations, imposed by being relegated to a corner in a course of mineralogy, which is itself frequently merely taken as a subsidiary part of a course in geology. There are strong indications that the time has now arrived, however, when these limitations should be swept away, and the fact boldly recognised that the child has outgrown the parent, and that crystallography has become a wide and important subject on its own account, embracing (1) crystal morphology; (2) the optics and other physical properties of organised solids; (3) mineralogy; and (4) the crystallography of metals. Recent progress in the subject has been so rapid, its importance has become so palpably enhanced, that partial presentments of the character of the book before us are entirely behind the times, and no longer called for, except for the convenience of a particular set of students who may desire to have their professor's lectures before them in print.

While from the latter point of view it is possible to say much that is good about the book, there are some defects that cannot be ignored. The illustrations of crystals, for instance, are obviously in many cases inaccurately drawn, that is, not in clinographic or any other projection correctly to their proper elements, but are merely approximations of the nature of ruled rough sketches; hence, lines which should be parallel are often conspicuously not so. Also while one is glad to see a greater tendency than in other French books on this subject to employ the simple and scientific symbols of Miller for the crystal faces and forms, the advantages of which are fully admitted by the author, the notation of Levy is still given as well in conformity with French usage, although the probable confusion to the mind of the student would appear to dictate its abandonment as an unnecessary complication, especially considering the limited time available for the crystallographic part of the curriculum of these students.

A further limitation is the marked tendency to base the whole crystal morphology exclusively on the laws of Haüy as expanded by Mallard, and on the space-lattices of Bravais. Now it will be clear from the following review of Prof. Sommerfeldt's book how great is the importance of the space-lattice; but this book goes to the other extreme in stopping short at this work of the French savants. The only work on homogeneous structures referred to beyond it is that of Schönflies, and this, moreover, is only dealt with briefly as an afterthought in an appendix, and apparently largely as a development of the mathematical work of Jordan. No mention could be found of the work of Sohncke, von Fedorow, or Barlow, in developing the 230 types of homogeneous structures possible to crystals.

Curiously enough, the part of the book most diffidently presented, the optical, is the most readable and interesting, and is marked with originality of distinct value. Indeed, this section leaves the reader with the wish that it had been extended, as the author appears to be on specially familiar and congenial ground.

(3) This is a suggestive little book, the main object of which appears to be to present a simplification of the mode of regarding the homogeneous structure of crystals as a complicated point-system of the character indicated by Sohncke. Its essence is that the space-lattice (Raumgitter) is considered as the basis of the structure. The method is to drop the idea of essen-

tial parallelism, same-ways orientation, of the structural units, and to develop systematically in stages, starting from parallelism in the holohedral class of a crystal system, the possibilities of alternation and other forms of partial parallelism. The idea is justified from two points of view, first, that of the simplification for the student, who can readily construct the fourteen models of the Bravais space-lattices, by means of knitting needles and spherical balls impaled on them, and indicate on them if he chooses the stages of parallelism, corresponding to the various classes, by means of little inclined rods or other devices for indicating differences in the nature of the nodes of the space-lattice; and secondly, from the point of view of the undoubted importance of the space-lattice as regards crystal structure, and the fact that the space-lattice represents the arrangement of the molecules, while the Sohnckian points clustered around its nodes represent the arrangement of the atoms, and that models of such Sohnckian systems of points are very difficult to construct.

An excellent series of stereoscopic photographs of the fourteen space-lattices are given, forming quite a feature of the book, the photographs not merely representing the spherical balls on the steel rods but the shape in stereographic projection of the solid formed by the elementary cell or unit "brick" of the crystal edifice. The photographs were taken from models in the laboratory of Prof. von Groth at Munich. It is interesting to note also that the system of closest packing, as used by Pope and Barlow, is adopted in the book.

After a few pages of instruction in the elementary facts and nomenclature of crystallography, the author passes on to compare holohedral and partial symmetry, and shows how by placing a short inclined stroke, rod, or bar at each point of intersection or node of a space-lattice, and doing so either parallelwise or in an alternately arranged manner, the idea of parallelism or otherwise, and even of a screw arrangement, may be indicated directly on the space-lattice itself, the disposition of the cluster of Sohnckian points about each node of the space-lattice being thus indicated by the mode of arranging the little stroke or rod. It is shown that such an arrangement fulfils Wiener's principle, that homogeneity consists in the continual repetition throughout space of the same relation between an elementary atom and the entire structure. The diagrams in the second part of the book indicate how this idea of constructing all the variations of class symmetry of a crystal-system on separate models of the same space-lattice can be carried out, and the book is well worth attention on account of the simplification which it thus presents of the admittedly most difficult part of crystallography. The difference between right- and left-handed mirror-image forms is also very clearly brought out.

While the particular mode of applying these ideas of Prof. Sommerfeldt is new, it can scarcely be said that the principle is. For Mr. Barlow long ago employed models of the human hand at the nodes of the space-lattice, or about them, to indicate orientational differences of the atomic cluster which each such node represents. But the present mode of differentiation employed by the professor of mineralogy of Tübingen has the especial merit of emphasising in an unmistakable manner the importance of the space-lattice as the fundamental basis of crystal structure.

A. E. H. T.

MODERN EXPLOSIVES.

Les Explosifs modernes. By Paul F. Chalon. Troisième édition. Pp. 787. (Paris: Librairie Ch. Béranger, 1911.) Price 25 francs.

THIS volume is really an encyclopædia on the subject of explosives, although many of the materials described, however interesting, are scarcely to be regarded as explosives, for it is only in very exceptional circumstances that they can behave as such or enter into the composition of explosive mixtures.

The book is divided into five parts, dealing respectively with (i.) explosive substances and the primary materials employed in the industry; (ii.) the manufacture of powders and explosives; (iii.) pyrotechny; (iv.) the methods of employing powders and explosives; (v.) employment of explosives for mining and various other applications; (vi.) legislation.

It would indeed be difficult to turn to the book for information on any substance which has either been employed or suggested for use as an explosive for any purpose, and the author has certainly carried out the descriptive part of the work in a thorough manner, the recent improvements in manufacture, for example, with guncotton and nitroglycerine at Waltham Abbey, being satisfactorily dealt with.

No doubt the author as a mining engineer feels the necessity of including much matter which is familiar to the chemist or manufacturer, such, for example, as the percentage composition of common salts, the different series of hydrocarbons, alcohols, &c., but it is to be regretted that chemical formulæ are so frequently incorrectly given that a lengthy errata, mainly to correct these chemical faults, is required, but even this fails to cover all the sins of commission.

Many interesting substances, unfamiliar even to those engaged in the industry, are briefly described, such as the remarkable crystalline explosive salts resulting from the electrolysis of solutions of antimony with an antimony anode, the sulphides and selenides of nitrogen, the sulphide of carbon C_8S_5, which compares with iodide of nitrogen in sensitiveness. In dealing with the explosive nature of compressed acetylene, the author states that its use has had to be abandoned in view of its explosive character, yet by the simple compression into steel cylinders containing porous blocks saturated with acetone, acetylene is now a valuable commercial product, and is largely employed in conjunction with oxygen for cutting steel plates, welding, and other purposes where a high temperature is demanded.

The author's connection with mining ensures that the application of various explosives for blasting purposes, submarine blasting for the removal of obstructions to navigation, including sunken vessels, is

fully treated, and many of the testing galleries employed for investigating the safety of explosives in coal mines are described. Many suggestions for the substitution of perfectly safe bodies in lieu of true explosives for this purpose are referred to. Among these may be noted the use of quicklime and its expansion on slaking; cartridges charged with liquid carbon dioxide or oxygen; but one of the most interesting methods was that introduced by M. Linde for the use of liquid air, in some cases a paper cartridge filled with kieselguhr and saturated with petroleum was then dipped in liquid air, the firing being carried out by a Bickford fuse or fulminate detonator. When the Simplon Tunnel was commenced in 1899 several attempts were made to utilise the explosive force of liquid air mixed with flour for blasting the rocks, but with unfavourable results. Liquid air alone, in metal cartridges, has also been tried for bringing down coal, but the author concludes that it does not seem an economic success.

Of more general interest is the important question of modern smokeless powders as propellants for military purposes. The Powers are fairly evenly divided in the choice between a gelatinised nitrocellulose powder or a nitrocellulose-nitroglycerine colloid. At one time the majority favoured the simple nitrocellulose powder, which is still retained by France and Russia, whilst Great Britain remains faithful to cordite, and Italy to ballistite. Germany may be said to be in a transition stage, for whilst employing a nitrocellulose for field guns, for the larger naval weapons a powder very similar to our modified cordite is employed.

All have had troubles to face with premature decomposition in magazines, and especially France. At Saigon in 1897 a quantity of poudre B ignited without setting fire to some black powder stored near by. 19,500 kilogrammes of this same powder had burnt with little damage in the previous year at the Saint-Médard factory, but the *Jena* disaster will ever be most prominently associated with this particular explosive, to which, in the author's opinion, it was wrongly attributed, whereas the special Commission appointed to inquire into the cause of this disaster believed it to be due to spontaneous decomposition of poudre B.

The instability of smokeless powders has led to the introduction of "stabilisers," the action of which is to absorb the oxides of nitrogen resulting from decomposition, which oxides, if present uncombined, greatly accelerate further decomposition. The author mentions a number of these, which include urea (American powder), diphenylamine (ballistite and the French powder BBo, first introduced after the *Jena* disaster), amyl alcohol (in the most recent French powders, AM_2 and AM_8), which appears to give excellent results. In cordite the vaseline acts as the stabiliser, although originally introduced for quite other purposes. It does not follow that for powders containing both nitroglycerine and nitrocellulose two stabilisers, one for each constituent, should be provided, as the author appears to think necessary.

Summarising the question of relative stability of the two classes of propellants the statement is made that gelatinised nitrated cottons possess more stability than the nitroglycerine-nitrocellulose powders, and although the velocity of the projectile is lower for the same charge they have marked advantages in lower temperatures on detonation, less erosive action on the rifling of the guns, and give less smoke. In view of the troubles experienced with simple nitrocellulose powders, the claim of their superior stability, *per se*, to cordite is open to question.

On the whole the volume will be found a useful work of reference on the composition, manufacture, and application of explosives for practically all purposes. It is more essentially a book suited to the requirements of the engineer or mining expert, and would not afford much information to the chemist or those engaged in the manufacture of explosives.

J. S. S. B.

A STATE MEDICAL SERVICE.

The Dawn of the Health Age. By Dr. B. Moore. Pp. ix+204. (London: J. and A. Churchill; Liverpool: The Liverpool Booksellers' Co., Ltd., 1911.) Price 3*s*. 6*d*. net.

THIS is a remarkable and noteworthy book, powerfully written, and very convincing on most of the points raised. Its aim is to demonstrate the necessity for entirely remodelling the present system of medical service, in the interests of the whole community. It goes far to show that hundreds of thousands of lives and millions of money could be saved annually if diseases were attacked on more scientific principles; and the main theme is that we allow diseases to invade and enfeeble us, and then make an attempt (often a poor one) at cure, instead of concentrating our efforts on prevention.

The first chapter is headed, "How we tinker with disease instead of stopping it." Therein it is pointed out that concerted, statesman-like action is demanded. The present undisciplined mob must be converted into a disciplined army; and there are signs foreshadowed by legislation dealing with some of the great problems of social reform, commencing with invalidity insurance and reform of the Poor Law, that we are turning in this direction. The organised army of doctors would cost the nation from eight to ten millions a year—an amount which is at present exceeded, but in a nationalised medical service the money would be paid through different channels. Under the new *régime*, medical treatment would be as free to everyone as is the education of to-day, and everyone would be bound to accept medical treatment in his own interests, just as to-day he accepts the education of his child. The author estimates that tuberculosis costs the country 16,000,000*l*. a year, and that it can be eradicated for an expenditure of less than 10,000,000*l*. a year for ten years, further expenditure almost stopping at the end of that period. He further maintains that tuberculosis and preventable infantile mortality together cost us more than double the price of an effectual national service for their prevention.

The main object of the national medical service would be twofold:—

(1) To give instruction in the laws of hygiene and healthy living, sowing this knowledge broadcast in both school and workshop.

(2) To take effective steps to stamp out infectious disease, assuming compulsory powers for this purpose.

We require a new system, including in organic coordination the private practitioners, the hospitals (voluntary and Poor Law), and their staffs, the infectious diseases and municipal hospitals and their staffs, the dispensaries, public and provident, the district medical officers and relieving officers, and the present so-called public health service.

"Let us wake up and be truly ashamed of ourselves," and having taught the school teachers the principles of hygiene, provide that this subject is taught in our schools as a compulsory and important one. Under our present medical service neither the medical practitioner nor the public health officer has any ambition to go forth and find the disease, not even if an epidemic is on; the disease must come to the doctor. The service is the more defective and incomplete in that many infectious diseases, and these often the most dangerous, are not even compulsorily notified.

It is maintained that a national medical service must arise in the end out of the general sickness and invalidity scheme now being contemplated by the Government. It is obvious that both the more economical and scientific way of dealing with disease is to catch it early and to stop it at its source.

"So much of medical practice is becoming inefficient under the action of some of the local cooperative systems, clubs, societies, and tontines, that it is making the name of medical science a disgrace. It is turning doctors' private practices into fraudulently conducted business concerns, in which the doctor loses all dignity and self-respect, and the patient is cheated of that advice and treatment which he imagines is being given to him, and upon which his very life depends."

The last thing in this world to have cheap is medical advice. State insurance with a nationalised medical service is the only way out from this chaos. The medical officers should be transferable from one local centre to another, and open to promotion from one place to another. It is a liberal estimate to take the average income of the profession at 250*l.* per annum. The average annual pay for the doctor, under the State national medical service, would be somewhat more than 300*l.* a year, and taking it that a junior commenced at about 150*l.* a year, this would mean a system rising on ordinary promotions and good service to a maximum of 1000*l.*, and a small number of administrative officers at higher salaries. Probably about one-third of the profession would elect to remain on in private practice. The whole scheme would not be nearly so costly as the provision required under the Old Age Pensions Act, and it would prove quite as popular and as beneficial. The gain in disease stopped at incipient stages, and in increased health and corresponding power of his workpeople, together with regularity of work, less interrupted by illness, would more than repay the employer for his part of the contribution.

"At least one adult in every seven of us is going to die of consumption, all because of this nefarious 'Wait till your ill system,' which no one has the courage to attack, and because we will not send doctors out on the highways and byways to find disease and haul it apart, so that they may stand between the healthy and infected, and the plague be stayed. As it is with consumption so it is with a hundred and one other disease conditions."

The author deals with our hospital system, its evils and abuses. It is argued that these provisions are only capable of doing about 15 per cent. of the work which they are intended to do; but they are a hopeless failure and a positive drawback, because they stand in the way of the introduction of a properly organised scientific effort. An organised system of State-controlled hospitals, in true coordination instead of chaos, would bring about a reduction of at least 50 per cent. of both disease and expense. The present hospitals are hopelessly out of touch with the present medical practitioners throughout the country, and this is highly detrimental to the public service, the hospitals themselves, and to the medical profession.

"Under a State medical service and State hospitals for all members of the wage-earning classes, hospital abuse is done away with, because it simply cannot exist. The out-patient departments of our hospitals, like the 6*d.* dispensary practice of our slums, are two disgraces on the fair name and reputation of medical science. In both cases the times given are wholly inadequate for observation, care, and attention to the cases."

The writer demonstrates that the race is not relieved from suffering and death by the existence of a cure for the individual.

"There is only one way given under heaven by which disease can be abolished and a finer and fitter race evolved, and that is by stopping the cause of disease, and throwing all our energies into the resistance of its spread."

Without a fairly complete separation of infective consumptives, no progress of any kind is possible. Therein lies the solution of that problem.

"If we could only see the patients hit by the infection of phthisis as we do in smallpox the present order of things would not long be tolerated. As we are free from hydrophobia, so can we be free from tuberculosis when we find a statesman of the courage and fortitude of Mr. Walter Long to lead us to victory."

It is pointed out that in the evolution of the national medical service the friendly societies will be absorbed, the service will be thrown open to the whole of the medical profession, retiring allowances will be provided, and a State medical examination would become the single portal of entry to the medical profession which is so desirable. The voluntary hospitals would soon step into line with the rest of the service, and accept State support and control. The district assigned to each doctor would contain some four or five hundred families or houses. He would have a surgery; he would have no rivals worrying him, no bills to bother about, no suspense lest his patient

thought he was after fees, and it would be to his interest to reduce work by keeping in touch at all times with the people for whose health he is responsible. He would at the same time act as an educating influence, and the absence of the dread of a fee to pay would further promote early treatment.

GEOLOGY FOR STUDENTS.

A Text-Book of Geology. By P. Lake and R. H. Rastall. Pp. xvi+494. (London: E. Arnold, 1910.) Price 16*s*. net.

THIS text-book will fill the gap between several excellent books of a more primary character and the great English work of reference which we owe to Sir Archibald Geikie. Mr. Rastall is responsible for the physical portion, and Mr. Lake for that dealing with stratigraphy.

Dr. J. E. Marr, as editor of "Arnold's Geological Series," to which the work belongs, states in his preface that

"the stratigraphical portion of the book is occupied almost entirely with the study of the stratigraphy of the British Isles, which is sufficient for the purposes of elementary teaching."

This, however, is just the point on which there may be most difference of opinion. It may seem to some of us that in elementary teaching a view of the earth's history should be imparted on the broadest scale. The gaps in our insular stratified series should be filled in unhesitatingly from other lands. The progress of living things from Palæozoic to Quaternary types can be followed with interest even by a beginner in geology; but few people can take delight in British genera and species unless they can picture them in a setting of the successive faunas of the globe. The early editions of Lyell's "Principles of Geology" are appealed to by Dr. Marr as an example, yet nothing is more prominent in Lyell's work than his desire to establish a stratified sequence by observations made in many lands. Consider his table of "Recent and Tertiary Formations," on p. 61 of his third volume, published in 1833, and compare it with Mr. Lake's treatment of the same formations on pp. 439 and 453 of this modern text-book. Lyell, with a fascinating sweep, reminds us in his table of the delta of the Ganges, of Uddevalla, of Asti, and Perpignan, of the Superga, and of the volcanoes of the Velay. On p. 46 he regrets his ignorance of "many deposits known to exist in Spain and Portugal."

Many of us still share Lyell's regret, not because we want to carry in our heads the list of fossil species found on particular horizons, but because we want to fit the beds into the general scheme of stratified deposits. Lyell took his marine fossils as "medals which nature has chiefly selected to record the history of the former changes of the globe." Our universities, since his time, have established the cult of zones and horizons within the British Isles. The British Isles, moreover, have been accepted as consisting of England and Wales, and attention has become more and more concentrated on a limited area of the European outpost. Mr. Lake has worked well under these conditions, and no one will accuse him of ignorance of the wider aspects of the earth. We expect, however, a "text-book of geology" to convey to us some picture of the progress of life upon the globe. Of this we find only scanty traces in the 200 pages devoted to stratigraphical geology. The word "stratigraphical" has been allowed to dominate this section rigidly. In this respect numerous smaller text-books come nearer to the Lyellian conception of geology.

Mr. Lake's treatise, however, is indispensable for those who wish to bring their knowledge of British strata up to date. He has included, for instance, Mr. J. F. N. Green's revision of the St. David's area (p. 298); the probability of an unconformity in the Bala series, emphasising its division into Caradocian and Ashgillian (pp. 318 and 320); and Mr. Clement Reid's assignment of an Upper Oligocene age to the plant-beds of Bovey Tracey (p. 452).

A Scottish geologist may be provoked to find that the rocks which form the main mass of his highlands are described in six lines (p. 297). An Irish geologist will regret that the Dingle problem is dismissed in twenty-six words (p. 352), while the Lower London Tertiaries occupy two noble pages. But this lack of proportion is written large in the programmes of our public examinations.

Mr. Rastall's chapters on physical geology naturally make a wider appeal. Even the Dwyka conglomerate of South Africa is shown in one of the photographic plates, though no explanation appears to be given of its remarkably interesting characters. Spitsbergen and Alaska are well referred to, and the Tonga Islands, the great cone of Misti, and the wind-scored Sphinx, are used as illustrations of features that have a broad significance. The plates are chosen with much care, and the diagrams are as lucid as the accompanying text. Good examples of the author's treatment are to be found in the passages on desert-erosion (p. 69), and on river-capture (p. 45). Where so many physical matters have to be dealt with, few authors will agree as to the degree of prominence to be given to each. We should have liked to hear more of the many varieties of gneisses, and we note that the author regards thermal metamorphism as "usually of comparatively limited extent," a statement that is true enough of the rocks exposed in England. In the Transvaal, Rhodesia, Fennoscandia, and Canada, examples of a very different order may be found. Rock-cleavage is clearly described, and is illustrated by plates iv. and v., which might well be transferred, with their text, to the chapter on metamorphism two hundred and forty pages further on.

Mr. Rastall shows as much caution (pp. 100, 101, &c.) in dealing with the work of ice as his colleague does (p. 464) in dealing with the glacial epoch; but the main results of observation are very fairly stated, and the lessons of Arctic lands are applied to the British Isles. Is Spitsbergen, however, to be described (p. 99) as "a region of heavy precipitation"? Where the actual amount of melting is slight, glaciers, fed by broad snow expanses, can be maintained in an almost arid climate.

In this excellently produced book we have come across no misprints. "Porphyry," in the table on

p. 238 seems a slip for the "syenite-porphyry" of p. 243. On p. 147, for "Skeat" read "Skeats." One or two prominent terms, like *roches moutonnées* and strain-slip cleavage, remain unnoticed in the truly admirable index. GRENVILLE A. J. COLE.

BIOLOGICAL CHEMISTRY.

An Introduction to Bacteriological and Enzyme Chemistry. By Dr. G. J. Fowler. Pp. viii+328. (London: Edward Arnold, n.d.) Price 7s. 6d. net.

IN this work we welcome a valuable contribution to the scanty English literature of a subject of vast and constantly growing importance. A great increase of interest in biological chemistry and a consequent rapid development of the subject along almost innumerable lines have been among the most noticeable features in the history of chemistry during the last ten or fifteen years. Stimulated by the brilliant successes of Fischer and the important researches of Buchner, many workers have devoted themselves to the study of biochemical problems, and especially to the investigation of enzyme action. Accompanying this scientific movement, and no doubt in part responsible for it, there has been a widespread introduction of biological methods into the routine experience alike of the industrial and analytical chemist. The subjects of agricultural and dairy chemistry, water analysis and sewage disposal, to say nothing of the advance in the old-established fermentation industries, at once suggest themselves as instances of this tendency, and an audience has thus been created anxious for authoritative information on the principles underlying the application of biology to all these questions.

It is to this audience that Dr. Fowler has addressed the main portion of his book. Anxious to meet the needs not only of the chemist, but of the engineer and medical officer of health, and even of the general reader, he has, however, included a chapter on general organic chemistry which it is to be feared will be found superfluous by the chemist, and will be "caviare to the general." Apart from this the plan of the book is excellent. The chief types of enzyme action and of the chemical action of bacteria are first discussed, along with the chemistry of the sugars and proteins, substances which play so important a part in all biochemical changes, and the book culminates in three chapters describing the relation of all these matters to agriculture, sewage disposal, and various industries. The treatment throughout is clear and practical, the excellent method being adopted of quoting as far as possible actual experimental results and methods from the original sources, and thus enabling the reader to appreciate the lines on which successful investigation of such problems must be shaped.

As might be expected in a book ranging somewhat lightly over a large field of detailed information, occasional inaccuracies are to be found. Thus the lactic and acetic fermentations (p. 13) have both been obtained by Buchner with cells killed by acetone; the discussion of the mutarotation of glucose might easily be understood to mean that the change is due to equilibrium occurring between the aldehyde and one of the oxide forms of glucose (p. 98). More serious fault is to be found with the description of the well-known guaiacum test for peroxidases, along with the typical albumin reactions, as characteristic properties of enzymes in general (p. 104). Peroxidases are now recognised as a distinct and individual class of enzymes and it is at least highly probable that many enzymes are not proteins, and among them diastase itself, in connection with which these tests are quoted. Something, moreover, has gone seriously wrong both with the formulæ and argument on p. 173.

Some of the subjects touched upon are of fascinating interest, a notable example being found in the chapter on the "Cycle of Nitrogen." This is, of course, a matter of the most fundamental economic importance, and one with which the author is specially qualified to deal.

For all who feel any curiosity about biological chemistry this book should serve as an excellent introduction, and it should be difficult for anyone to read it without realising some of that glamour which has attracted so many workers to the investigation of the chemistry of living beings. A. HARDEN.

WEST GREENLAND ESKIMO.

Bei den Eskimos in Westgrönland. Ergebnisse einer Sommerreise im Jahre, 1906. By Dr. R. Trebitsch. Nebst einem ethnologischen Anhang, von Dr. M. Haberlandt. Pp. xxiii+162+map. (Berlin: Dietrich Reimer (Ernst Vohsen), 1910.) Price 8 marks.

DR. TREBITSCH gives a very readable and capitally illustrated account of his twelve weeks' journey in western Greenland. Considering how large was the distance covered in this short time, it is creditable to him how much information was collected. West Greenland, between 73° N. lat., and Cape Farewell, is in the possession of Denmark. The entire trade is in the hands of the Kgl. grönländischen Handel, a Government concern, somewhat similar to our old East India Company, and there are stringent regulations to prevent intrusion by other Powers. Travellers must have a valid pretext for going, must undergo medical inspection, and are not allowed to take intoxicants into the country.

It was only as a collector of phonographic records for the K. Akademie d. Wissenschaften of Vienna that Dr. Trebitsch could get leave at Copenhagen to visit West Greenland. The country is divided into districts, the chief town of each is a "colony," where lives a Government official, who is at the same time the sole trader; other officials, mainly natives, are scattered about at trading centres. The Danish *régime* is apparently beneficial; for the West Greenlanders have increased from 6,286 in 1820 to 11,790 in 1904, a striking contrast to the state of affairs among the Eskimo of Alaska. The writings of Dr. Boas and others have taught us to expect some degree of uniformity of culture among the Eskimo, despite their vast extension over some 5000 miles of coast line, but the similarity between the seal-hunting appliances of the Alaskan Eskimo and West Greenlanders is none the less striking; the same talent for drawing and the custom of vying with each other in composing songs are met with among both groups.

The author collected masks, though Andree and others have denied this occurrence in Greenland, which are probably used for magico-religious purposes, as in Alaska. He unduly emphasises the similarity of type occasionally found between Eskimo and American Indians, which he attributes to kinship of race. The low stature of the Eskimo he regards as an adaptation to the climate of the far north, as the strong storms do not permit tall plants to grow, and suggests that the lack of hair on the face of the pure Eskimo is consequent on the inconvenience caused by the formation of icicles! West Greenlanders are for the most part of mixed Eskimo and Danish origin; in fact, the largest "colony" boasts of only one pure-bred Eskimo.

The seal plays a very large part in the life of the Eskimo, and Dr. Trebitsch gives some interesting details of the methods employed in capturing it. The kayak is provided with a square white sail, almost concealing the hunter, which the seal is supposed to mistake for an iceberg. The seal is first shot with a rifle, and then harpooned, so that the harpoon float may prevent it from sinking. In winter two men use a harpoon with a composite shaft some 6 metres long. A very large and a small hole are bored in the ice; one hunter lies down peering into the former, and when he catches sight of a seal he moves the harpoon point to and fro in the small hole, which attracts the seal. At the right moment both men thrust the harpoon with all their might. This mode of hunting is called "he looks through a hole." In East Greenland bait is employed. The mainland Eskimo, however, always wait for a seal to come up to a breathing hole.

Native social customs are considerably in abeyance among the Christianised Eskimo, but the author was sometimes able to secure traces of the past; for instance, one missionary allowed the performance of one of the old native dances. The songs and stories, of which a large collection of phonographic records was taken, are in many cases modern, but some are manifestly old, and refer to cannibalism, exchange of wives, and the mating of girls with animals. Many of the songs have a homely vein. In some cases the distribution of the folk-tales is discussed. There is an ethnological appendix by Dr. M. Haberlandt, who describes the objects collected by Dr. Trebitsch for the Vienna Museum. A. C. HADDON.

A VETERAN ANTHROPOLOGIST.

Memories of Eighty Years. By Dr. John Beddoe, F.R.S. Pp. xi+322. (Bristol: J. W. Arrowsmith; London: Simpkin, Marshall and Co., Ltd., 1910.) Price 7s. 6d. net.

DR. BEDDOE has followed the example of another distinguished anthropologist, the late Sir Francis Galton, in writing the memories of his life. This practice is to be commended, as it furnishes not only pleasant reading with a great deal of human interest, but also valuable material for the future historian of anthropology.

Dr. Beddoe, who may well be regarded as the founder of field anthropology, since he began making observations on hair and eye colours seventy years ago, records in this book the leading events of a long and active career. Born in 1826, on the English side of the Welsh border, he started life as a student of law, but soon abandoned that for the more congenial study of medicine. He acquired his medical knowledge at University College, London, and the University of Edinburgh.

In 1854 he went out to the Crimea as a member of a civil medical staff, where, though he had very little medical service to perform, he had the opportunity of making observations on many Oriental races. After his return from the Crimea, he decided to complete his medical studies at Vienna, and he gives an interesting account of his journey through Holland, Germany, and Bohemia, with many valuable and original observations on the ethnological features of the races he encountered on the way. He met van der Hoeven in Holland, and Virchow at Berlin. In Vienna he found the upper classes were of the Germanic type, and the lower orders very mixed, with a large Slavic element.

On leaving Vienna he returned to England through Italy and France, adding much to his knowledge of the races of those countries, which at that date were unexplored fields for the anthropologist. He finally settled down as a medical practitioner in Bristol.

The long list of anthropological papers published by Dr. Beddoe shows how persistently the rest of his life has been devoted to his favourite science.

In 1867 he was awarded a prize of 100 guineas by the Welsh National Eisteddfod for the best essay on the origin of the English nation, which was afterwards embodied in his classical book on the "Races of Britain."

He was the proposer of the first anthropometric committee of the British Association, and also the initiator of a separate section for anthropology at the B.A. In 1889 he was president of the Anthropological Institute, and he gives many interesting details about the amalgamation of the two older anthropological societies to form the institution which at present represents anthropology in this country.

Even now, in his eighty-fifth year, Dr. Beddoe's mental keenness and activity would put to shame that of most younger men.

PHYSICAL CHEMISTRY.

Introduction to Physical Chemistry. By Prof. J. Walker, F.R.S. Sixth edition. Pp. xii+417. (London: Macmillan and Co., Ltd., 1910.) Price 10s. net.

AFTER a useful life of eleven years, this well-known text-book appears in a thoroughly revised edition, in which, no doubt, it will continue to be a standard work. At first sight it appears as if the size of the work had remained sensibly constant—to use a favourite term of physical chemistry—actually there has been an increase of 27 per cent., and the additional chapters on alloys, hydrates, colloidal solutions, dimensions of atoms and molecules, neutrality and salt hydrolysis, electromotive force, polarisation and electrolysis, and radio-active transformations have

added much to its value. Of these the chapter on alloys may be mentioned as a particularly successful piece of exposition.

The book reflects as much as ever the spirit of a very true believer in the ionic dissociation hypothesis, and little emphasis is given to the difficulties and objections or to the criticism by which it has been assailed. Although in an elementary work an author can scarcely be expected to go into great detail, it must be remembered that the English student still finds himself in an atmosphere where there is a good deal of objurgation about the ionic theory, and if Prof. Walker had dealt with the difficulties collectively it would probably have been a convenience to students.

The following points have been noted for remark in the course of reading. On p. 83 the wording may readily give the impression that the vapour rising from a boiling salt solution has a temperature of 100° C., a matter on which there is a widely prevalent misconception among students. On p. 227 it would have been well to explain why the Brownian movement is compatible with the conventional assumption that a body suspended in a liquid is subject to equal pressure in every direction. The explanation of "salting out," on p. 347, as a process depending *solely* on ionic concentration is scarcely justifiable. Lastly, Prof. Walker has used throughout the book his system of chloridion, sulphation sodion, &c., nomenclature. The present writer took exception privately to this nomenclature when it was first proposed, but was assured that with experience he would learn its value to students. This prediction has not been fulfilled, and whatever philosophical defence may be made of the system, he remains of the opinion that it is not helpful. A. S.

BRITAIN'S BIRDS.

Britain's Birds and their Nests. Described by A. Landsborough Thomson, with introduction by Prof. J. A. Thomson. 132 drawings in colour by G. Rankin. Pp. xxviii+340. (London: W. and R. Chambers, Ltd., 1910.)

ANOTHER gorgeous volume on Britain's birds and their nests! Truly of the making of books on this subject there seems no end. Happy the publishers, and authors we presume, supported by a public with so insatiable an appetite for British ornithology. We could exhaust the space at our disposal with a mere list of the books and serials on this subject which are issuing or have issued from the press within the past two years and have come under notice in these pages. The name on the title-page of a gifted professor in a great northern university, as introducer of his son as author has given special zest to the perusal of this particular volume.

Prof. Arthur Thomson writes an introduction to "Mr. Rankin's beautiful pictures and my son's text." We must, much to our regret, however, confess to considerable disappointment in the volume before us. The text is excellent. Indeed, the various biographies are pleasantly written, and very accurate as a whole, but little really appears to have been left for Mr. Landsborough Thomson to say that has not already been often told.

But it is with the plates that fault is chiefly to be found. They are all "very pretty," but we have more of art than of nature in them. We suspect that they are mostly studio pictures rather than out-of-door studies. Without exception the species Mr. Rankin has depicted are the most "proper" series of British birds we have ever made the acquaintance of. They never foul the ground, when 'tis their nature to; they never disturb a blade of grass or a single petal of the beautiful flowers that emborder their nests in nearly every case. They are indeed the most æsthetic company we have yet met with, in the choice of nesting sites.

We miss, too, in many of the plates, the characteristic attitude of the bird represented. There is something lacking in the pose of the herring gull to those familiar with it "in the open." In the thick-knee the beak is too thin and its eye too small; in the corncrake the true ralline attitude has not been caught. We failed to recognise the nidifugous nestling figured on plate 88, Fig. 3, as a young partridge until we had consulted the reference.

As to the eggs figured, it would be quite impossible for even one well acquainted with them in many cases to determine their parentage from the plates. Their size—no dimensions being given in the text—is also quite undeterminable, and their colour often far from true to nature. There is no doubt that as regards tint the three-colour process is very often to blame; but where it fails some indication should be given in the text.

The author, yet a very young man, shows by this ambitious venture into the world of books that he is possessed of "the passion of the ornithologist," and by it gives promise that we may expect from him an ornithological work "going far beyond the recording of occurrences," to quote his father's words, "and the observations of movements important and indispensable as these and similar inquiries are."

OUR BOOK SHELF.

An Introduction to Experimental Psychology. By Dr. C. S. Myers. (The Cambridge Manuals of Science and Literature.) Pp. vii+156. (Cambridge: University Press, 1911.) Price 1s. net.

IN this little book Dr. Myers gives a very interesting account of modern views in certain parts of the science of experimental psychology. The topics selected for discussion, and forming the headlines of successive chapters, are:—"Touch, Temperature, and Pain," "Colour Vision," "The Müller-Lyer Illusion," "Experimental Æsthetics," "Memory," and "Mental Tests and their Uses" (two chapters). On each of these subjects much important work has been done within quite recent years, and the exceptionally clear way in which the author sums up the latest results and brings out their theoretical importance will make the book of great value to physicians, educationists, and others who are finding a knowledge of the general methods and results of the science an indispensable supplement to their ordinarily-recognised intellectual equipment.

The first chapter contains a full account of the recent researches of Drs. Rivers and Head on human nerve division, which have modified so extensively our views on tactile sensibility. The chapter on the Müller-

Lyer illusion describes an extremely interesting example of the success with which careful psychological experimentation, supplemented by exact measurement, can analyse out the various hidden factors involved in the production of an optical illusion. Colour vision and experimental æsthetics are treated in a way which cannot fail to interest the ordinary educated reader. But the parts of the book which deserve to be singled out as of particular interest for applied science, educational or medical, and as a really masterly description, in a small compass, of work perhaps most characteristic of modern psychological advance, are the chapters on memory and on mental tests and their uses. Readers of the author's larger text-book of "Experimental Psychology," will recognise in the former a condensation of the excellent account of the subject in that book. The discussion of mental tests includes clear instructions as to the method to be employed in applying certain of the more important of them, and gives a summary of many of the results, which will be found exceedingly useful to readers who have not the time or the facilities for referring to the original publications. Such questions as the effect of alcohol and other drugs upon muscular work and fatigue, the standardisation of intelligence, and the correlation of mental abilities one with another, will all be found adequately treated.

The book contains a bibliography and index, and is artistically bound and very clearly printed.

W. B.

Grundzüge der Mathematisch-Physikalischen Akustik. by Prof. A. Kalähne. Teil i., pp. vii+130. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 3.20 marks.

This little work forms an excellent introduction to the mathematical basis of acoustics. Though using the calculus freely wherever needed, including differential equations, the treatment is simple and full, the analysis being illustrated by numerical examples and corresponding diagrams drawn to scale. The present part (being the first of two) is divided into seven chapters. Of these the first is devoted to vibrations and waves in general, the second to Fouriér's series and harmonic analysis, while the third deals with the musical intervals of the scale, and kindred topics. Then, the subject being introduced, its formal development follows. The fourth and fifth chapters treat the vibrations of a particle, undamped and damped respectively. The sixth chapter deals with resonance and forced vibrations, the concluding chapter extending the treatment to systems of more degrees of freedom and their coupled vibrations. Perhaps to the English reader the most valuable features of the work are the tables and the curves giving concrete expression to the numerical illustrations. The growth of forced vibrations and the sharpness of resonance are very well shown, and may serve as a reminder of the electrical work of V. Bjerknes, Zenneck, and others in Hertzian waves and wireless telegraphy.

E. H. B.

Physical Measurements. By Prof. A. W. Duff and Prof. A. W. Ewell. Second edition, revised and enlarged. Pp. x+258. (London: J. and A. Churchill, 1911.) Price 7s. 6d. net.

This book is intended by the authors for students who have already completed an elementary course of practical physics. It is not, however, a treatise on methods of physical measurement, but the authors have described upwards of seventy typical experiments of an advanced and modern character. While the descriptions of these experiments are usually applicable to apparatus in general, they are in many cases somewhat sparse in detail. Thus, for example, in Expt. lxiii., "Strength of a Magnetic Field by Bismuth Spiral," no remarks are made on the necessity of maintaining the temperature of the spiral constant, which is of primary importance if trustworthy results are to be obtained by this method. These defects are, however, partially remedied by the references given by the authors at the commencement of each experiment to more advanced treatises and sources where the subject under investigation is dealt with more exhaustively. Such well-known text-books as Kohlrausch, Watson, and Stewart and Gee figure conspicuously in this respect. The authors consider that the books and papers referred to in this way should be consulted by the student before commencing the experiment. A few questions are usually appended to each experiment bearing upon its subject-matter, At the end of the book are tables of logarithms and physical constants.

In the diagram on p. 70 (hypsometer) surely it is better to connect the pressure gauge directly with the inner cylinder of the hypsometer. The following experiment, No. xiv., p. 71, would have been better described as "Linear Coefficient of Expansion" and not "Temperature Coefficient of Expansion."

If the book is used in conjunction with the references it will prove of value to the student of physics.

Unsterblichkeit: Eine Kritik der Beziehungen zwischen Naturgeschenen und menschlicher Vorstellungswelt. By Hermann Graf Keyserling. Zweite Auflage. Pp. iv+285. (Munich: J. F. Lehmann, 1911.) Price 5 marks.

In the review of the first edition of this work (Nature, vol. lxxxii., p. 5, November 4, 1909) it was pointed out that the fundamental idea was that of faith as a permanent and essential constituent of human movement along the lines both of thought and of action. In the present edition, this is the single point of view, and the concluding chapters of the original work, amounting to about sixty pages, are now included in the author's "Prolegomena zur Naturphilosophie." The work is rich in thought and represents a noteworthy contribution of a naturalist to the human concept of immortality.

Elementary Regional Geography. Europe and the Mediterranean Region. By J. B. Reynolds. Pp. viii+184. (London: A. and C. Black, 1911.) Price 1s. 4d.

Cambridge County Geographies. Berkshire. By H. W. Monckton. (Cambridge: University Press, 1911.) Price 1s. 6d.

Maps and other illustrations take the most prominent place in Miss Reynolds's little book on Europe. The volume should form a useful introduction to the subject for young people, but it would have been more suitable for this purpose if the children had been provided with more work to do for themselves.

Mr. Monckton's book on "Berkshire" is a worthy addition to an interesting series; it has all the good qualities noticed in connection with its companion volumes.

Space and Spirit. A Commentary upon the Work of Sir Oliver Lodge, entitled "Life and Matter." By R. A. Kennedy. Second edition. Pp. 64. (London: Charles Knight and Co., Ltd., 1911.) Price 1s. 6d. net.

The first edition of this booklet was reviewed at some length in our issue of February 24, 1910 (vol. lxxxii., p. 486). The new edition contains some further contributions by way of appendix, and a new list of definitions.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Solar Eclipse of April 28.

THE failure of the observers at Vavau to obtain a satisfactory view of the eclipse is very unfortunate, and the whole astronomical world will share their disappointment. It is welcome news to hear that perfect conditions prevailed at islands situated some distance from Vavau, and equally well placed as regards the line of totality.

I have received a letter from Mr. C. L. Wragge, who observed the eclipse under ideal conditions from the island of Moungaone in the Tongan group. He writes to me from Lifuka as follows:—

"It was entirely successful, with a clear sky, and magnificent beyond words. A lovely sketch to scale was also secured by another member of my special party at Lifuka—duration of totality, about two minutes. Four great streamers were seen.

"The shadow-bands rippling over the cocoanuts, and the dark purplish-black of the ocean, obliterating the lovely tinges of blue and green water around the coral reefs, were superb.

"The natives rushed into their houses, and came out and cheered when, with a blaze of glory, the sun reappeared."

The photographs secured have been taken back to New Zealand for development, but a sketch enclosed with the letter shows the corona with four magnificent streamers of the type characteristic of the solar sunspot minimum, and also a very large prominence. The streamers and inner corona are described as "silver-white," and the following *approximate* measurements are given:—

Highest streamer of corona, about 649,000 miles.

Large red flame, about 217,000 miles.

The streamers were in pairs, two extending north-east and two south-west, while silver-white ridges of the inner corona extended round the north-west quadrant.

CHARLES W. RAFFETY.

2 Park Hill Road, East Croydon, Surrey, June 18.

Dinoflagellates and Diatoms on the Beach.

IN walking across the beach between tide-marks at Port Erin on April 7, I noticed a greenish-brown discoloration of the sand in places—especially along the edges of the ripple-marks and other depressions—which I supposed to be caused by a deposit of diatoms. The examination of a sample in the laboratory soon showed, however, that although a few diatoms (*Navicula amphisbaena*, or some closely allied form) are present, by far the greater part of the deposit is formed of the active little peridinian or dinoflagellate *Amphidinium operculatum*, Clap. and Lachm., which has not, so far as I can ascertain, been previously recorded on the British coast.

The innumerable specimens of Amphidinium were all alive, reproducing by longitudinal fission, and very active in their movements. They would leave the sand-grains to which they were adhering, swim round rapidly in the water, and then settle down again upon a sand-grain. These dinoflagellates remained abundant on the beach at Port Erin until the end of April, when the observers had to return to Liverpool. During these weeks the patches of discoloured sand changed a little with each tide, increasing, diminishing, shifting, or even disappearing for a day, and then reappearing. Samples placed in dishes of sand and sea-water in the Biological Station flourished, and the organisms increased so as to form a dark-coloured layer over the sand, eventually rendering the water impure and causing the death of the dinoflagellates.

At the meeting of the Linnean Society on June 1 I directed attention to this unusual occurrence of this small Amphidinium in vast quantities, and exhibited specimens. Two days later I was again on the beach at Port Erin, and found what were apparently the same patches of discoloured sand, but on examining scrapings with the microscope saw that the deposit was now wholly composed of a golden-yellow diatom, one of the "*amphisbaena* group" of Navicula. I searched the beach carefully between tide-marks, and examined samples from every suspected patch of sand, but could find no trace of the Amphidinium so abundant a few weeks before. The Navicula, which was present in April in very small quantities, seems completely to have replaced the dinoflagellate. We have probably much to learn in regard to the comings and goings of such microscopic forms and their physiological inter-relations in connection with what may be called "the metabolism of the beach."

W. A. HERDMAN.

Liverpool, June 12.

A New Method of Chemical Analysis.

WILL you permit me to step outside usual practice in this instance and to direct wider attention to the exceptionally brilliant and momentous work described to the Royal Institution on Friday evening, April 7, by its present professor of natural philosophy, as reported in NATURE of June 1, p. 466? OLIVER LODGE.

THE author of the present note is probably one of the few chemists living who was originally brought up in the Berzelian electrochemical theory (for which idea Berzelius was indebted to Davy), and, as shown in an article published in 1877 (see also Arrhenius-Jubelband), he made a sharp distinction between elements playing the "electro-positive" and "electronegative" *rôle*. So, *e.g.*, the connection between the position of elements in Mendeléeff's periodic system and their valency was expressed thus: The *positive* valency of the elements (towards the negative oxygen) may change between 1 and 8; the *negative* valency (towards the positive hydrogen) may change between 1 and 4 only.

But such ideas, for which I was formerly reproached of being "unmodern," are very modern indeed to-day.

This is seen from the highly interesting lecture, published in NATURE of June 1, by Sir J. J. Thomson, "A New Method of Chemical Analysis" (p. 466 *et seq.*).

Without referring to the results communicated in this lecture with anything but high admiration, I beg to point out that Sir J. J. Thomson finds that, when the elements hydrogen and carbon had passed—originally positively charged—through the kathodes of his tubes, they appear also *negatively* charged. This he calls "remarkable, for *hydrogen* is generally considered to be a strongly *electro-positive* element," and "the atom of *carbon*, also regarded as an *electro-positive* element, is also conspicuous on the *negative* side."

I desire to remark that there is an analogy, but also a certain difference, between the notion "positive" and "negative" as used by the chemist or by the physicist. Physically, and also chemically, a positive atom carries positive charges, and the negative atom *vice versa*. This holds good of Sir J. J. Thomson's atoms (see the article) and of the atoms in solutions which we chemists call "ions." The difference lies in the point that, as regards the atoms constituting the chemical *compounds*, the terms "*positive*" and "*negative*" have only a *relative* value, as pointed out in the introductory lines. Hydrogen is *positive* towards chlorine in hydrogen chloride, H_+Cl_-, and many other compounds, whereas it forms the *negative* constituent of potassium hydride, K_+H_-, and other similar compounds (CaH_2, LaH_3, CeH_4, &c.).

The physical analogy of this relativity is the zero position of hydrogen in the electrical tension series. It is *positive* compared with the "noble" metals and the metalloids; it is *negative* compared with the "ignoble" metals like those of the alkalies, alkaline earths, and the earths.

As regards carbon, it is *positive* in C_+O_{2-}, but it is *negative* in $H_{4+}C_-$ and in the more popular calcium carbide, Ca_+C_{2-}.

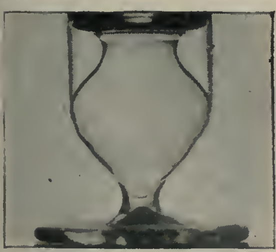
In the compounds KH, CaC_2, and also in $Na_{3+}N_-$ we had already suspected latent negative chemical ions. Chemists will be indebted to Sir J. J. Thomson that he has shown their existence physically. It is interesting, but not surprising, that the said elements take up negative charges under the conditions of his experiments.

BOHUSLAV BRAUNER.

Bohemian University, Prague, June 6.

The Formation of Stable Columns of Liquids.

When a liquid of slightly greater density than water is poured into a shallow layer of the latter, it is often possible to produce the formation shown in the accompanying photograph, in which the heavier liquid appears as a column of curved outline, stretched by its own weight, and hanging from the surface of the water. By performing the experiment in the following manner, the production of the column is rendered easy and certain. A test-tube of the dimensions shown in the photograph, preferably furnished with a foot, is filled to about one half the height of the hemispherical end with water, and 5 to 10 c.c. of aceto-acetic ether are then added. Usually, the formation of the column is automatic; if it should fail to form the contents should be shaken up, and the test-tube allowed to stand for a short time, when the liquids will settle as shown. Water globules entangled in the aceto-acetic ether may be removed by drawing to the side with a wire.



If the original layer of water be too deep, the column will break at its narrowest part, and the same occurs if water be poured gradually into the tube after the column has formed. By varying the width of the vessel, a great variety of shapes may be obtained, all of which are perfectly stable. The water is in all cases displaced from the lower part of the vessel, and bounds the sides of the column of heavier liquid. Similar results may be obtained with aniline, orthotoluidine, butyl benzoate, and some other liquids; but in these instances the manipulation is rather more difficult, owing to the tendency to break up into separate globules. By placing the test-tube in a flat-sided vessel and surrounding with water, the column may be projected on a screen, thus furnishing an interesting lecture experiment on the subject of surface tension.

Chas. R. Darling.

THE CORONATION.

From the point of view of social psychology to-day's great ceremony may be said to bind together in a circle of symbolism the past history of the English people and the present interests of the British Empire. From the point of view of individual psychology it may be regarded as a symbolic elevation of human personality to its highest power.

It is an interesting problem for the sociologist how far a given social ceremony succeeds in realising a modern content in an ancient form. The relation of form and content in social ceremonies and institutions alike is analogous to that of structure and function in organisms. But the inertia of social forms is far greater than that of organic structures, for in the case of the latter there is neither sentiment nor tradition to assist survival.

The development of the ceremony of crowning from Greek and Roman times is clear, but the origins of the crown-symbol itself are still obscure. Outside the sphere of classical antiquity its use is rare. But within it, as in mediæval and modern Europe, the crown is, next to the King, the central feature of coronation. Not only in popular language, but in legal phraseology, it is a synonym for the kingly office itself. It has, in fact, long ago superseded unction as the central element of royal investiture, making the recipient a king rather than a priest.

The crown of the kings of Egypt was, like regalia generally, considered divine. Kings of the Yorubas sacrifice sheep to their own crowns. In South Celebes it is the regalia that reign; the king is but their representative. If we attempt to penetrate to the strata of early custom which preceded the Greek and Roman kingly crown, the Athenian crowns which were given, just as ribbons of the Legion of Honour are given, the Roman crowns corresponding to the Victoria Cross and similar honours, the Greek wreaths of sacred leaves won in the games, and even the oak chaplet of the early Roman kings identifying them with the oak-god, we may follow some such line as the following. Like unction, crowning had its origin in personal decoration or accoutrement. Savage chiefs are sometimes invested with a girdle. Just as ankle and wrist straps and the like are frequently worn by rude peoples for the practical purpose of protecting the joints and ligaments, and afterwards attract superstitious ideas, such as the idea that they prevent the soul from escaping, so it may have been with the head-band or head-dress, originally used for protection or for confining the hair. The brain being the crown of the human organism, the head has always received honour. From this point of view the crown is the one royal symbol likely to be retained by enlightened peoples, who for various reasons retain kingship.

Coronations in other latitudes are instructive. Investiture with a special or sacred dress is frequently the main feature. The king-elect of the Aztecs went in procession to the temple. Here, after paying homage to the god, he was anointed over the whole of the body by the high priest, and sprinkled with holy water. The unguent was a black oil of rubber. He was then clothed in ceremonial robes, and about his neck was hung a gourd containing remedies against sorcery, disease, and treason. Hindu coronations took the form of a baptism or an unction. Eighteen ingredients were required for the holy water, one being the water of the sacred river Sarasvati. After a preliminary sprinkling, the king received a bow and arrows, with which he symbolically conquered the four quarters of heaven and earth. Then, seated on a tiger-skin, facing the east, he received the holy water in a shower from a rose-head of gold. Four officiators poured it. Many prayers were recited meanwhile, some "to enable him to discharge his duties," others to the "divine quickeners"; others stated that he was being consecrated by the gods, and being filled with divine force. Vigour and vitality, royal and priestly dignity, were contained in the ingredients of the holy water. His head was then adorned with stalks of holy grass and ears of corn. At the end he quaffed a draught of the sacred soma. His hair was not to be cut for a year after the ceremony. In modern times a Rajput raja is anointed with sandal-paste and rose-water, and the priest marks his forehead with the sacred Tika symbol. When the raja of the Bhuiyas is consecrated, a chief winds a flexible creeper round his head-dress to signify that he is "Lord of the forest."

Ellis describes the installation of Tahitian kings. The king bathed, and was then ceremonially struck by the priest with a sacred branch. He was then girded with a sacred girdle of red feathers, which rendered him divine. In old Siam the king was placed under the seven-tiered umbrella, the great symbol of royalty. A crown and a collar of diamonds were placed upon him, and he received a golden tube containing his name. In old China the king (like Plato's philosopher-kings) deprecated his elevation, declaring himself to be unworthy. No crown was used; the king was seated upon the throne of the Nine Heavens. In Abyssinia, that most curious pioneer of Christian kingdoms, there

was a pretty piece of symbolism. The king rode on horseback, to find his way barred by a company of girls holding a barrier consisting of a cord of crimson silk. They plied him with the question: Who are you? Then, after an exhibition of horsemanship, the king severed the barrier with his sword. The priests then intervened, anointed, crowned, and incensed him. It was, no doubt, at the same period that Ptolemy Philadelphus of Egypt reduced crowning to an absurdity. At his coronation, Athenæus tells us, three thousand two hundred crowns of gold were carried in procession, and one of these was a hundred and twenty feet in circumference.

Our own ceremony is a wonderful mosaic of survivals. Its main features are the recognition of the king by the people; the oath of good government; the anointing; the delivery of the regalia; the imposition of the crown; the delivery of "the most valuable thing that this world affords," the Bible; the enthroning; the reception of homage. Among the regalia the antiquary may miss "the hand of justice" of the emperors of the Holy Roman Empire. The most ancient feature, the unction, of course, derives from Hebrew ritual, as the crowning from Roman. The combination of the two marks the combination of spiritual and temporal power, and is a curious echo of "primitive" kingship, when the monarch possessed both material authority and supernatural *mana,* and was both president and priest. Unction in its evolution always shows a connection with spiritual ideas; the vehicle is itself a source of life, and, when consecrated, inspires the recipient. But its ultimate origin is the use of oil as part of the festal garb. At one end of the scale we have the Australian medicine-man "singing" a charm of power into a magic ointment; at the other Plato conceives the fancy that the Soul of the Universe was impressed upon material nature by the Creator as an unction in the form of a cross.

To the student of man it is interesting to observe that all these elements of the ceremony except the "recognition," have only lost their original magical import, and become symbolic, within the last eight or nine hundred years. He may ask himself whether the imagination of the people really accepts unction as expressive of modern thought and modern life; whether there is not too much "survival" in the whole ceremony to enable it to retain any living meaning. Dead forms, he may note, are always dangerous. If we still possessed the art and craft of ceremony, new forms might be evolved. It is remarkable that the whole essence of the ancient ritual not only does not contain any recognition of the one great motive force of modern civilisation, science, on which all progress, all wealth, and even all existence increasingly depend, but is actually a negation of it.

A really living symbolism is to be found in the "recognition" of the King by the people. This might form the nucleus of a representative ceremonial adequate to our times. Those present to "recognise" would be representative of every factor that helps to make the Empire, and in proportional numbers and prominence. Other countries have realised this opportunity. At every great State function in Germany a prominent place is assigned to the representatives of pure and applied science; the German mind realises that the wealth and well-being of the empire ultimately depend on science, and science alone. It is a pity that those responsible for the organisation of our ceremony sympathise so strongly with its archaic elements that they have not secured an adequate representation of the depositaries of modern knowledge, the true palladium of people and of empire.

A. E. CRAWLEY.

AËRIAL NAVIGATION AND MECHANICS.[1]

THE exigencies of modern aëronautics combined with the uncertainties attaching to aëroplane flight are slowly but gradually directing attention to the necessity of researches and original papers of a highly specialised character, dealing with air pressures and the motions of bodies acted on by them. The question thus becomes imminent: Where should such investigations be published?

Until now no attempt has been made to make use of journals and transactions of societies publishing physical papers, and articles full of formulæ, diagrams, and tables have generally found their way into periodicals of a semi-popular or practical character, devoted to general aëronautical or engineering questions. The result has not always been satisfactory, and it has often been a question as to whether the printing of the formulæ or the reproduction of the diagrams has suffered the most. The insufficiency of the existing media for the publication of theoretical articles on aëronautics is, however, more clearly shown by asking the question: What is to be done with a manuscript of 100 foolscap pages filled from beginning to end with long formulæ or diagrams? Further, whatever may be the drawbacks of the system of refereeing papers no doubt can exist as to the advantages of a collection of memoirs, all of which have been subjected to the judgment and criticism of external examiners.

The Government Blue-books contain exactly the kind of investigations to which these remarks apply, and the hope may therefore be expressed that these will in the future become a recognised medium for the publication of lengthy investigations which have been approved by the Government Committee.

The "Report" for 1909–10 consists of (1) records of experiments performed at the National Physical Laboratory; (2) original papers by members of the committee and others; (3) abstracts of papers of a scientific character dealing with aëronautical problems.

Probably the features which possess the greatest interest for the large majority of readers are the abstracts and reports on the state of science with regard to specified subjects. The thirty-five pages of general abstracts do for aëronautical science what is done for physics and electrical engineering by "Science Abstracts." In order to make the collection more complete the compilers have included papers published some time ago; for example, abstract No. 8, deals with Turnbull's experiments, which were published in *The Physical Review* for 1907.

Mr. F. J. Selby's special reports on the present state of knowledge regarding electrification of balloons and on papers by Ferber, Crocco, and Soreau, dealing with equations of motion and stability considerations, form a valuable contribution of a similar character. It is interesting to notice that several stability conditions in the papers referred to are defective, owing to the

[1] Report of the Advisory Committee for Aëronautics for the year 1909–1910. Pp. 191. (London: H.M. Stationery Office; Wyman and Sons, Ltd.; Edinburgh: Oliver Boyd; Dublin: E. Ponsonby, Ltd., 1910.) Cd. 5282. Price 8*s.* 5*d.*

Interim Report on the work for the Year 1910–11. Pp. 30. Cd. 5453. (London: H.M. Stationery Office; Wyman and Sons, Ltd.; Edinburgh: Oliver Boyd; Dublin: E. Ponsonby, Ltd.) Price 1*s.* 2*d.*

Report on the Theory of a Stream Line past a Plane Barrier, and of the Discontinuity arising at the Edge, with the application of the theory to an Aëroplane. By Sir George Greenhill, F.R.S. Pp. 96+106 figs. (Advisory Committee for Aëronautics Reports and Memoranda, No. 19.) (London: H.M. Stationery Office; Wyman and Sons, Ltd.; Edinburgh: Oliver Boyd; Dublin: E. Ponsonby, Ltd., 1910.) Price 5*s.*

"The Aëroplane, an elementary text-book on the principles of dynamic flight." By T. O'B. Hubbard, J. H. Ledeboer, and C. C. Turner. Pp. xi+128. (London: Longmans, Green, and Co., 1911.) Price 2*s.* 6*d.* net.

"The Mechanics of the Earth's Atmosphere, a collection of Translations." By Cleveland Abbe. Third Collection. Pp. iv+617. (Washington, D.C.: Smithsonian Institution, 1910.) (Smithsonian Miscellaneous Collections, Vol. li., No. 4 Hodgkins Fund.)

failure of the writers to take account of sufficient data, and in particular to appreciate the interdependence of the equations of motion, and this is the less easy to understand as this interdependence in the case of lateral stability is clearly pointed out in Lanchester's "Aërodonetics."

The report on electrification of balloons is followed by brief accounts of experiments by Messrs. G. W. Walker and W. Makower. The subject is an important one, the neglect of which may be responsible for at least one serious dirigible fatality in Germany. Rear-Admiral Bacon gives a translation and abstract of the programmes of the German Society for the Study of Airships.

Passing, however, to the articles dealing with "researches," we find voluminous descriptions of apparatus and diagrams of experimental details, none too easy to follow, which may well suggest to the uninitiated reader to ask, "What has all this to do with aëronautics?" A doubt may readily arise as to whether the structural details of a wind tower, experiments on a fish-shaped body moving in water, or a diagram showing the weather conditions prevailing on a certain day at Portsmouth or Berwick will in any way reduce the record of a score of people killed, besides those wounded by accidents during the first four months of the present year. The inclusion of unnecessary *minutiae* will only tend to strengthen the violent attacks which were made recently on the work of the committee by a well-known motorist writing in a popular magazine. The writer in question took up the well-known "practical" attitude, and suggested that if the Government wanted to do any good they should buy a commercial aëroplane; they should keep their committee muzzled (so to speak), and should only consult them when the machine got out of order, in which case they should be expected to rectify the mischief, presumably, at a few hours' notice. This, according to the writer, was the condition under which experts in English commercial firms labour, and he was shocked at the idea of a Government committee having any free will as to what they were to do.

It is hardly necessary to point out in NATURE that no body of scientific men would consent to serve on a committee under conditions so detrimental to efficiency, or to direct attention to the waste of money which occurs when experts are called on to patch up defects which, under more favourable conditions, they could have anticipated previously. But it does appear that the bearing of many of these researches on aërial navigation has been considerably obscured by the inclusion of unnecessary matter which would have been better filed for future reference instead of being published.

At the present time, apart from stability and the construction of light motors, the most important problem of aërial navigation is the behaviour of aëroplanes and dirigibles in gusty winds, the determination of the maximum fluctuations, of the stresses these set up in the various surfaces and frameworks, and of the changes of motion they produce, and whether these involve loss of control. Now Dr. W. N. Shaw, F.R.S., of the Meteorological Office, has drawn up a report of about sixteen pages on "Details of Wind Structure," in which he states at the beginning, "In drawing up this statement, endeavour has been made to summarise briefly. Additional details can be supplied in further illustration if required." After the concise and lucid exposition which the author gives, it is rather a striking contrast to find more than forty sheets of diagrammatic details of records taken at particular places. These greatly increase the bulk of the volume, and in view of the previous work by Langley on "The Internal Work of the Wind," the provisions stated on p. 10 for enabling the records to be consulted might well have been utilised to save the cost of printing all these diagrams. Moreover, the scale of time is too small to show the intervals between the gusts, a detail of some importance.

The sections dealing with the measurement of pressures also contain a profusion of diagrams and mechanical details of a purely subsidiary character, and the general conclusions are not well stated. A good deal of space is taken up with the details of experiments in water, which would find a more natural place in the transactions of the Institution of Naval Architects than in a report on aëronautics.

The splendid equipment of the National Physical Laboratory at Teddington is described in six pages of letterpress by Dr. T. E. Stanton, but here again the diagrams are unnecessarily large and bulky, and a more useful purpose would have been served if these had been reduced, and the space used for a fuller exposition of the bearing of the experiments on aërial locomotion.

We notice that for experiments on the pressure on planes the use of a whirling table is not considered satisfactory, and that a wind tunnel has been preferred for the purpose. The main objection to this plan is that no attempts have been made so far to investigate the pressure distribution on a plate which has a movement of rotation as well as of translation. The results therefore can only apply to an aëroplane driven steadily through calm air, since when either free or forced oscillations take place rotation plays an important part in them. The experimental determination of these rotational effects will necessarily be difficult, and a whirling table suggests a possible method; at the same time results possessing even a very rough degree of accuracy are better than no results at all, and their absence limits the systematic investigation of aëroplane motions to machines the supporting surfaces of which are narrow. No reference to rotating planes is made in the programme of the committee.

If the committee instead of confining its attention to ideal surfaces, had discussed the application of its conclusions to the successful types of aëroplane and dirigible of the present day, the report would have better corresponded with its title.

The interim report on the Motor Prize Competition offered by Mr. P. Y. Alexander in 1909, which took place last July, exhibits the same features as the other reports. It contains details and diagrams of the friction dynamometers used for testing the motors, particulars as to the mode of estimating the weight of the latter, the quality and price of the petrol, the insurance of the maker's servants for employer's liability, the number of representatives allowed to be present at the tests, the temperature of the room, the times of day at which two pints of water were added to the radiators, and other details carried to the same degree of elaborateness; in short, everything except a statement of the general conclusions of a scientific character to be derived from the tests, as apart from mere statistics.

Sir George Greenhill's report is essentially a mathematical treatise on discontinuous motion, covering all the problems which have up to the present been solved. An important improvement has been made on the treatment given in the earlier text-books, by the introduction of constants. Old students of hydrodynamics will remember a difficulty that suggested itself arising from the fact that a solution might apply to a stream flowing past a lamina of breadth π with velocity 1, but it was not obvious what could be done if the breadth of the lamina were a and the velocity v. This treatise will be of great use to workers in our universities who are seeking to extend the applications of pure mathematics to physical

problems, and thus to furnish fresh starting points for experimental research.

The utility of measurements of the tensile strength of fabrics, of diffusion of hydrogen through membranes, and of a search for light alloys, are too obvious to need further comment, and the fourteen pages of the first report dealing with these questions are concise and to the point.

If there is one conclusion to be derived from a study of these reports it is that a serious mistake was made years ago when in America the grant for the late Dr. S. P. Langley's experiments was withdrawn. If the work now being done does not altogether make up the deficiencies caused by neglect in the past, it is gratifying to learn that experiments are progressing in this direction.

In a recent review of a translation by the editors of *The Aëronautical Journal,* the suggestion was made that they might well bring out further books on aviation. "The Aëroplane" provides in a small compass a summary of the general principles involved in aviation, and the hope expressed by the authors "that the book will find a sphere of usefulness as a comprehensive introduction to the latest and the most fascinating of sciences" is well supported by an examination of the contents. The first chapter deals with properties of the air, including meteorological considerations and relations between pressure temperature and density. The next two chapters are devoted to the flow of air round variously shaped bodies, its pressure on plane and curved surfaces, formulæ for the centre of pressure, and lift and drift. Then comes a study of gliders, in which the reader is asked to make a few experiments with a sheet of paper; stability and steering next follow. In the chapter on propulsion the main notions regarding "pitch" and "slip" are clearly defined. If the authors prepare a revised second edition they might, however, point out a little more clearly that a limit to the efficiency of screws is afforded by the fact that to obtain the maximum thrust there must be no forward motion, while if there is no slip there is no thrust. The next chapter deals with the leading present-day monoplanes and biplanes, giving their dimensions and advantages. Under "Navigation" great emphasis is laid on the importance of the parallelogram of velocities, though not called by that name, and stress is laid on the impossibility of finding the way when the earth is invisible, owing to winds. The last chapter, on "Motors," extends from the simple elastic to the gnome, and the bibliography, glossary, and tables will be found useful. But is there any glossary that contains all that is needed? "Angle of attack," "bent-up wings," and "single- and double-lifting aëroplanes" should certainly be recognised, or better terms substituted by the Aëronautical Society's committee. And are Mr. Hubbard and his colleagues correct in defining "angle of incidence" as the angle at which a plane is inclined to the horizontal? Moreover, the entry occurs, "*Pressure.*—See Resistance"; but resistance is not to be found.

In the third collection of papers and translations issued under the title of "The Mechanics of the Earth's Atmosphere," Dr. Cleveland Abbe has continued the task he has for some time been undertaking of introducing English-speaking students to the rapidly increasing literature that has arisen out of the efforts to break down the line of demarcation between meteorology and physics. The earliest application of the notions of mechanics to the earth's atmosphere in the present collection is Hadley's paper of 1735, on the cause of the trade winds. The study of rotational effects is next taken up in the papers of Poisson (1837), Tracy (1843), Braschmann and Erman (1859–62), Sprung (1881), Gorodensky (1904). Kerber's paper (1881) on the limits of the atmosphere is now reprinted in view of the interest attaching to the subject arising out of explorations with sounding balloons. The translation of Guldberg and Mohn's studies (1876–83) is due to Prof. Frank Waldo. We next have a series of papers by Von Bezold, dealing with the thermodynamics of the atmosphere and other considerations, and dating from 1892 to 1906, and, finally, the two memoirs of Margules (1901 and 1904), which, as the editor points out, introduce us to the great problems of the future—that is, the thermal transformations of energy persistently going on in the atmosphere. The collection might with advantage form the subject of courses of lectures in our universities, and the openings which the subject presents for original work are as numerous as they are intricate and complex. The student will be glad to have such a collection of literature rendered so easy of access.

THE SEA DYAKS OF BORNEO.[1]

IT is obvious that this pleasantly written book is not intended for the anthropologist, but is rather meant for that large class of readers who take a general interest in remote countries and strange peoples. Nor is Mr. Gomes in any special sense himself an anthropologist, a matter it is well to mention, since in some reviews considerable stress has been laid on the fact that no mention is made of the so-called *nyarong,* the "spirit helper" of the Dyaks. But even if the *nyarong*, or, as it should be spelt *ngarong*, is not mentioned by name, its existence is not ignored; an undoubted example will be found on p. 188, and it may be assumed that the reference to a Dyak of whom it is recorded on p. 143 that "he treated a snake with the greatest kindness, because it had been revealed to him in a dream that the spirit of his grandfather dwelt in that snake," is another example of the same belief.

With the possible exception of the Kenyahs, the Sea Dyaks are the most companionable and pleasant race in Sarawak, and it is clear that the author has enjoyed so considerable a measure of their friendship and confidence that, had he but possessed the necessary knowledge, he would have been able to write a book of great ethnological value. The work is thus one of the strongest arguments in favour of the preliminary training of missionaries that has fallen into our hands, for it is clear that its weaknesses are due to nothing but the author's lack of knowledge of where and how to look for information, since every page indicates his interest in his people and the trouble he has taken to know them.

The honesty and truthfulness of the Dyaks are described and illustrated by the *tugong bula,* the "liar's mound," which, once started, seems to persist long after the liar it commemorates is himself dead. A pile of branches is heaped up in memory of the man who has uttered a great lie, so that future generations may take warning. The persons deceived start the *tugong bula* by piling up the branches in some conspicuous spot by the side of the path from one village to another. Every passer-by contributes to it, and at the same time curses the man in memory of whom it is raised. "Once started, there seems to be no means of destroying a *tugong bula.* There used to be one by the side of the path between Seratok and Sebetan. As the branches and twigs that composed

[1] "Seventeen Years among the Sea Dyaks of Borneo." By E. H. Gomes, and an introduction by the Rev. J. Perham. Pp. 343. (London: Seeley and Co., Ltd., 1911.) Price 16s. net.

it often came over the path, on a hot day in dry weather I have more than once applied a match to it and burnt it down. In a very short time a new heap of branches and twigs was piled on the ashes of the old *tugong bula*." The author points out that a man prefers almost any other punishment than that of having a *tugong bula* erected to his memory, for other punishments are soon forgotten, while this remains as mute evidence against him for succeeding generations, and is a disgrace even to his children's children.

Mr. Gomes gives a good account of the Dyak burial rites, though it may be doubted whether the cemetery shown in the plate facing p. 136 is not in fact of Kenyah origin, and some of the accoutrements of the warriors shown in the other plates are not strictly Sea Dyak. The illustrations are perhaps the weak part of the book, for although they are all of excellent quality, there is not that variety in the subjects selected for reproduction which might legitimately be expected from one who has lived so long among the Dyaks. It would, however, be unfair to blame the author's judgment for this, as he was dependent on borrowed photographs, but he may be strongly recommended to learn to use a camera before returning to Sarawak.

C. G. S.

Dyak Houses. From "Seventeen Years among the Sea Dyaks of Borneo."

THE BIOLOGICAL STATIONS OF EUROPE.[1]

PROF. KOFOID'S report referred to below admirably fulfils the purposes for which he prepared it, namely, to put in convenient form for reference an account of the history, organisation, equipment, and work of the various biological stations of Europe, and to indicate their relations to research and to education of advanced or popular character. In the introduction he lays down some general guiding principles regarding the situation and functions of stations of different types—for research, teaching, and economic work—and gives some useful hints on fittings. Then follow descriptions of the stations, that of the Naples Station coming first. The inception, organisation, staff, financial arrangements, plans of the building (including floor plans and sections), details regarding aquarium fittings, pumps, pipes, valves, storage and circulation of water, apparatus, boats, and many other matters connected with this famous station are considered in a clear and concise manner, and the account, which extends over twenty-four pages, cannot fail to be of interest and of great use to those who have the management of, or are planning, marine stations.

The descriptions of other stations are not so detailed, but the chief features of each are mentioned, and opportunity is taken to give the details, often with a photograph or a drawing to scale, of any specially ingenious device or effective piece of apparatus, which the author observed during his tour of inspection. Plans are given of all the more important buildings, showing the arrangement of the laboratories, aquaria, workrooms, &c. Prof. Kofoid has earned the thanks of biologists by providing this excellent account of equipments and working arrangements.

The opening paragraph in the introduction to the stations of Great Britain is quoted here, as it so accurately states the conditions and limitations under which they carry on their work. Prof. Kofoid writes:—"The direct support of biological stations by educational funds of local or State origin, often in connection with universities, so generally prevalent in other European countries, is almost wholly lacking

[1] "The Biological Stations of Europe." By Prof. C. A. Kofoid. U.S. Bureau of Education, Bull. 1910, No. 4. Pp. 13, 360. 55 Pls., 48 text figs.

in Great Britain. With the single exception of the Gatty Laboratory at St. Andrews, which is supported by the university, the biological stations of England derive only meagre rentals of a few tables directly from university or educational funds. The stations have been forced, therefore, to turn to memberships of supporting societies composed to a considerable extent of scientific men themselves, to private benefactors, and to the commercial interests of the fisheries for aid. The result has been a relatively meagre and fluctuating financial support, a large, but, fortunately, rarely predominating amateur, as over against strictly scientific control, and a relatively very large absorption of the funds and activities of the British stations in scientific fisheries work. The scientific fisheries work done by the British stations is unsurpassed in its excellence and effectiveness, and the popular features, such as public aquaria, elementary and technical instruction, are generally well developed, but the strictly scientific phases of the station's activities too often suffer for lack of adequate financial support and from consequent loss of scientific interest."

The report describes the marine stations at Plymouth, Lowestoft, Cullercoats, Port Erin, Piel, Millport, and St. Andrews, and the Sutton Broads freshwater laboratory (which owes its origin and support entirely to private benefaction), and points out their special features and the facilities they offer. Appreciative reference is made to the teaching work carried on among the fishermen at Piel, as being mutually beneficial and leading to a better understanding, on the part of the investigators, of fisheries problems, and on the part of fishermen to a more just appreciation of the efforts of those who seek most wisely to preserve the resources of British waters.

The author urges that a well-equipped and scientifically maintained aquarium should form part of every marine station easily accessible to the public, for in no other way can attention be secured and instruction so forcefully conveyed as by the never-failing interest presented by living creatures well displayed.

The bulletin before us affords striking proof of the vitality of the principle carried into practice by the late Prof. Dohrn, for it shows that there are nearly one hundred institutions in Europe which may be classed as biological stations. These and the laboratories of a similar type in other lands, which owe their foundation to the stimulus and example given by Prof. Dohrn, have exerted an inestimable influence on biological science by placing the investigator in positions of greatest advantage with respect to living creatures, and by providing opportunities for long-continued and close observation and experiment upon abundant and varied material. Not the least valuable factor of such laboratories is the stimulus of contact with other investigators engaged in different lines of research.

In addition to the morphological and embryological researches, which, for many years constituted the chief work done in biological stations, these stations have in recent years facilitated the rapid extensions which have taken place in the domain of experimental physiology and in the wide application of experimental methods to the casual analysis of biological phenomena, thus helping materially to place the science on a broader and more comprehensive basis. During the past decade the work of biological stations has been more fully appreciated in regard to economic and industrial affairs, as is witnessed by the foundation of so many new laboratories on the continent of Europe, and by the increasing use of their facilities in medical instruction, in researches in comparative physiology, and especially in connection with the modern development of fisheries research. In this last direction it becomes increasingly evident that scientific investigations are imperative if the harvest of the sea is to be fully reaped and its resources to be maintained unimpaired for the future. But these investigations, while, of course, directed largely to the solution of the problems presented by the fisheries, must of necessity be founded on the broader basis of general biological inquiry. Fresh-water stations are likewise doing a sound work in regard to the problems of pisciculture, restoring and improving the sanitary conditions and food resources of the streams and lakes with which they are associated.

But apart from all economic problems, important though they are, the purely scientific aspect of the work of these stations wholly justifies their existence and the claims they have upon the community, for, to quote again from Prof. Kofoid's report,

The biological station is a unique agency in biological research, indispensable in the equipment of a nation for the upbuilding of leaders in biological teaching, and in the development and expansion of the spirit of research.

NOTES.

A WARM tribute to the value of the scientific work carried through in the West Indies by the Imperial Department of Agriculture was paid by the Prime Minister, Mr. Asquith, in a speech at a banquet given by the West Indian Club on June 15. In the course of his remarks, Mr. Asquith said:—"I desire to refer for a moment with the warmest appreciation to the work of the Central Department of Agriculture. Established in 1898 at the cost of the Imperial Government, presided over with distinguished ability first by Sir Daniel Morris and now by his successor, Dr. Watts, the work of that department is universally and gratefully acknowledged by the planters to be largely responsible for the improved state of affairs in all branches of agriculture, and I believe—I speak with some experience—it would be difficult to find a case in which any analogous experiment made by the Home Government has attained such speedy and satisfactory results. The outlook is thus full of promise, and not the less so by reason of the fact that the Panama Canal is now approaching completion. The ultimate effects of that great enterprise are, of course, at present incalculable, but it can hardly be doubted that it will in the long run favourably influence the economic progress of the West Indies." It is seldom that such warm commendation is given by a Minister, but the work that has been done merits it fully. So long ago as 1888, the value of botanical federation in the West Indies was urged in these columns, and several articles appeared relating to it and the starting of experiment stations and other aids to the development of the colonies. It is gratifying to find that after all the years which have elapsed since then the results are regarded with such satisfaction, not only by the persons closely concerned with the West Indies, but also by statesmen in the mother country.

A MEETING was held at the Colonial Office on June 14 to discuss with representatives of the self-governing Dominions and States a scheme for imperial coordination in the prevention of the spread of disease in agriculture and horticulture, which it is proposed to organise in connection with the Colonial Entomological Research Committee. An official report states that Lord Cromer, chairman of the Entomological Research Committee, explained the proposals, the object of which is to establish a central organisation in London for the transmission of

information to the various parts of the Empire, thus enabling them to legislate against the introduction of certain insect pests with a greater knowledge of the facts than would otherwise be possible. After a discussion, in the course of which the representatives expressed their hearty approval of the scheme, the following resolution, proposed by the Premier of New South Wales and seconded by the Premier of Tasmania, was passed unanimously:—"That this meeting is of opinion that the proposal to obtain and disseminate information of a scientific and useful nature, tending to prevent the spread by insects of diseases both in animals and plants to various Dominions and States of the Empire would be highly advantageous, and that steps should be taken to obtain the adhesion of the Dominions and States interested in the matter."

We notice with deep regret the announcement of the death, on June 16, of Sir Rubert Boyce, F.R.S., Holt professor of pathology in the University of Liverpool, in his forty-ninth year.

The Duke of Connaught has consented to become honorary president of the Royal Geographical Society.

The annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Thursday, July 6.

The council of the Royal Society of Arts, with the approval of the president, the Duke of Connaught, has awarded the Albert medal of the society for the current year to the Hon. Charles A. Parsons, C.B., F.R.S., for his experimental researches into the laws governing the efficient action of steam in engines of the turbine type, and for his invention of the reaction type of steam turbine and its practical applications to the generation of electricity, the ventilation of mines and other large spaces, blast-furnace work, ship propulsion, and other important purposes. The beneficial results which have followed upon these inventions include a cheapening of the production of mechanical power, greater economy and speed for steamships, and the first successful solution of the problem of rotary engines, which long had baffled many other inventors.

As already announced, the twenty-second annual conference of the Museums Association will be held in Brighton on July 10–15 next under the presidency of Mr. H. M. Platnauer, who will deliver his address on the morning of July 11. The same evening Dr. F. A. Bather, F.R.S., will deliver a public lecture on "Open-air Folk-Museums." The mornings of July 12 and 13 will be devoted to the reading of papers. Numerous excursions and receptions have been arranged for the visitors. The association was founded in 1889 with the object of improving and extending the work and usefulness of museums, the word being used in its widest sense to include collections illustrating pure and applied art, archæology, technology, and the natural sciences. Originally confined to the institutions of Great Britain and Ireland, the association has been joined by leading museums of all types in every part of the world, and now includes members from most countries of the world.

An appeal has been made by the British Empire League for funds to secure the establishment of a solar observatory in Australia. The need for such an observatory is strongly felt by solar physicists. A cooperative scheme of research has been initiated between the great solar observatories of Europe, America, and India whereby the sun may be continuously observed throughout the whole of the twenty-four hours, but a gap exists between the two latter stations which would be filled by a solar observatory in Australia. Mr. Geoffrey Duffield, on behalf of men of science, has personally pressed this subject on politicians in the Commonwealth, and Mr. Deakin has promised 1500*l.* a year upkeep if the sum of 10,000*l.* is privately forthcoming. 4000*l.* has already been offered in money and apparatus, so that 6000*l.* is still required. The scientific world will be grateful to the British Empire League for bringing the matter before members of the league and others, thus giving them an opportunity to support a movement which, if successful, will complete the chain of solar observatories which circle the earth, and enable the international scheme to be carried into complete effect. Mr. C. Freeman Murray, secretary of the league, Norfolk House, Laurence Pountney Hill, London, E.C., will be glad to receive and acknowledge any subscriptions which may be sent to him towards this important project.

An extra meeting of the Chemical Society was held on Wednesday, June 14, when Prof. T. W. Richards, of Harvard University, delivered the Faraday lecture, entitled "The Fundamental Properties of the Elements." The president, Prof. Percy F. Frankland, in introducing the lecturer, stated that the Chemical Society had assembled to celebrate what was one of the most important festivals in the calendar of the society, namely, the delivery of the Faraday lecture and the presentation of the Faraday medal. The significance of the meeting would be most effectively realised by calling to mind the names of the following illustrious men who had acted as Faraday lecturers since the first lecture was delivered by Jean Baptiste André Dumas in 1869:—Stanislao Cannizzaro, 1872; August Wilhelm von Hofmann, 1875; Charles Adolphe Wurtz, 1879; Hermann Ludwig Ferdinand von Helmholtz, 1881; Dmitri Ivanovitsch Mendeléeff, 1889; Lord Rayleigh, 1895; Wilhelm Ostwald, 1904; Emil Fischer, 1907. To these eminent *savants* the society had now added another in the person of Prof. Richards, whose great work and whose great contributions to science, especially his determination of atomic weights and his experiments on the compressibility of the elements, are not only well known in this country, but throughout the whole chemical world. Prof. Richards then delivered the Faraday lecture, of which we hope to print an abridgment in a subsequent issue. At the conclusion of the lecture the president, in presenting the Faraday medal to Prof. Richards, spoke of the sincere appreciation and the deep regard which his colleagues in this country had for his work, and also for the great and enduring importance which was attributed to his scientific discoveries. The vote of thanks to the lecturer, which was proposed by Prof. W. Odling, seconded by Sir William Tilden, and supported by Prof. Harold B. Dixon, concluded the meeting.

Mr. W. Hough, curator of ethnology in the United States National Museum, has prepared a descriptive catalogue of the valuable ethnographical collections made by Mr. Hoffman Philip, Minister and Consul-General at Addis Abeba, the capital of the Emperor Menelik. Ethnographical material from Abyssinia is notably scanty, and this large collection is interesting on account of the survivals which it exhibits from the ancient culture of northern Africa, the neighbouring Asiatic continent, and eastern Europe.

MR. R. TORII, under the title of "Études anthropologiques, Les Aborigènes de Formose," contributes to the Journal of Science issued by the Imperial University of Tokyo an introductory account of the primitive races of the island. The present portion consists of a list of the tribes with their geographical distribution, and it is accompanied by a large collection of photographs illustrating their physical appearance, environment, and occupations. Anthropologists will await with interest the publication in the journal of further instalments of the results of Mr. Torii's careful survey of these little known races.

MUCH has been written about the North-West Frontier Province, once an integral part of the Punjab, and specially interesting in connection with the restless Pathan tribes and the diversity of its physical characteristics. The problems which face the officers who control the relations of the British Government with the races within and beyond our border are discussed by a distinguished political officer, Mr. W. R. H. Merk, in a paper read before the Royal Society of Arts on May 25, and published in the society's journal. The conclusion of the writer, supported by Lord Minto and generally concurred in by Sir Mortimer Durand, Sir T. Holdich, and other authorities who joined in the discussion, is that, though we may expect occasional trouble from these tribes, our frontier policy is gradually attaining its object, and that it is possible that in the future this belt of rugged mountain territory will be, not a source of anxiety, but a barrier against aggression and a substantial addition to the security of India.

THE report of the Otago University Museum for 1910 records the gift to that institution of the valuable collection of Maori ethnology made by the late Dr. Hocken, who died on May 17, 1910.

IN the May number of *The Ottawa Naturalist* Mr. Lambe describes the skull of a new species of the bear-like genus Arctotherium from the Pleistocene of the Yukon. The genus, which is in some degree intermediate between Ursus and the extinct Old World Hyænarctus, has not hitherto been known north of California, and has accordingly been regarded as a southern type. The discovery of *A. yukonense* is therefore of considerable importance, as indicative of the northern origin of these huge, big-headed bears, and thus of the probable genetic connection with Hyænarctus.

WE have received the first section of a work to be published by Messrs. Friendländer, of Berlin, under the title of "Nomenclator animalium generum et subgenerum," in two volumes, at the price of 5*l.* The section received is devoted to the Primates. The various names are arranged in generic order, without any reference to the species by which they are typified. When names have been misspelt, they are frequently quoted as if they were new terms proposed by those responsible for such errors, without any clue as to their real origin, as, for instance, in the case of Aulaxinus for Aulaxinuus.

THE discovery in the autumn of 1907 of mummified carcases of mammoths and rhinoceroses in the ozokerit deposits of the Starunia district of eastern Galicia gave rise to considerable interest at the time. The specimens were transferred to the museum at Lemberg, where the skin of the rhinoceros has been set up, and an illustrated account of both specimens, by Mr. E. L. Niezabitowski, has been published in the April number of the *Anzeiger d. Akad. d. Wissenschaften in Krakau*. The rhinoceros belongs to the woolly species (*Rhinoceros antiquitatis*), and so well is the head preserved, that the author has been enabled to compare it in detail with that of its nearest relative, the existing white rhinoceros of Africa. The species presenting the next nearest relationship appears to be the European Pleistocene *R. mercki*. The hair of the Starunia rhinoceros had disappeared.

IN *The British Medical Journal* for June 3 (p. 1310) Dr. Leonard Hill and Mr. Martin Flack publish a second note on the comparative nutritive value of white, standard, and whole-meal bread when used as food for rats. The experiments show still more conclusively than in their first note (see NATURE, May 11, p. 355) the deficiency of white bread as a food, and the better nutritive qualities of standard and whole-meal breads. The germ seems to contain adjuvant bodies whereby the tryptophane-containing portions of the proteins are split off in larger amount and more easily when it is present in the flour.

IN his annual report for the year 1910, recently issued, Dr. Herbert Williams, medical officer of health for the Port of London, describes the incidence of plague among the rats and the measures taken for plague destruction in the port. Plague has now appeared among the rats for three years in succession: in 1908 in the West India Dock during five weeks in August and September; in 1909 seven dead rats which were proved to have died of plague were found in the South-West India Dock; and in 1910 three dead plague rats were picked up in the Royal Albert Dock. Of 199 rats captured and examined last year, only three were plague-infected. Dr. Williams remarks that this occurrence of plague among the rats three years in succession indicates the need for special vigilance.

THE rhythmic character of the movement exhibited by the plasmodia of Myxomycetes is discussed by Dr. V. Vouk in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxix., part viii.). The progressive and regressive flows together constitute a rhythmic period, which is found to be tolerably constant for the main streams of any given plasmodium. The period increases up to a certain point with the age and size of the plasmodium. Obviously mechanical stimuli upset the rhythmic flow.

THE frequent occurrence of localised hailstorms, generally of very short duration, as a typical phenomenon during late spring and summer in Missouri and Nebraska, prompted an investigation into the injury caused to forest trees, the results of which are communicated by Mr. F. J. Phillips in the Transactions of the Academy of Sciences (vol. xix., No. 3). Catalpa, sycamore, and mulberry suffered most both in the matter of defoliation and bark wounds. The soft nature of the bark on cotton wood and box elder was also apparent in the damage sustained. It is suggested that hail injury increases the development of *Polystictus versicolor* on Catalpa.

A NOTE on fungi collected in clay mines is communicated by Mr. P. Spaulding to the report of the Missouri Botanical Garden (1910). The greater number of the specimens were growing on the oak timbers used as supports. *Polystictus versicolor* and *Merulius lachrymans* were generally common, and *Merulius rubellus* was abundant in one mine. Stalked pendant forms of *Hydnum erinaceus* and *Schizophyllum commune* were also found. Only one fungus, *Fomes annosus*, was observed on the pine timbers, and *Coprinus atramentarius* was growing on the clay.

AN explanation of the differences observable in specimens of the common garden shrub, *Osmanthus Aquifolium*, is offered by Dr. O. Stapf in *The Kew Bulletin* (No. 4), as he is able to identify two plants, distinct both in foliage and flowers. The type of the original species has a leaf like the holly, and bears both hermaphrodite and staminate flowers. Another type, having leaves with shallower indentations, and for which only staminate flowers are known, fits in with a species segregated long ago as *Osmanthus Fortunei*. It has been suggested that the latter represents a hybrid between *O. Aquifolium* and *O. fragrans*; this opinion is supported by the characters, including the less hardy constitution, of *O. Fortunei*. Another item of horticultural interest is supplied by the note acknowledging the receipt of seeds of trees and shrubs collected in south-west China by Mr. Forrest. They include a number of rhododendrons, in connection with which the question arises whether any of them will supply a yellow-flowered hardy shrub so long desired.

THE systems of training and pruning fruit trees followed by the Japanese, as is the case with so many of their methods, are essentially different from those prevailing in European countries. According to the account by Prof. T. Ikeda, published in the Journal of the Royal Horticultural Society (vol. xxxvi., part iii.), a system—known as "tana"—of training the branches on overhead trellis-work is generally adopted for pears and vines, less often for plum and apple trees. The trellis is made of bamboos or wire fitted on wooden posts at a height of $5\frac{1}{2}$ feet and one to two feet apart; the pruning is very light, and is generally done in winter. Tana-training is said to offer advantages, notably in the matter of early fruit production and of protection from wind and rain storms. A more vigorous system of pruning is adopted in the case of Kaki trees, *Diospyros Kaki*, that appears to have arisen out of the practice of pulling the fruit with a portion of branch suitable for hanging it up to dry. The fruiting shoots are broken at the base, while the sterile shoots are left intact to produce spurs the next year.

WHAT is popularly known as "blackhead" in turkeys covers several different diseases, but one has been studied in some detail by Hadley and Amison, of the Rhode Island Agricultural Experiment Station, and traced to flagellated protozoa occurring in the cœcum. The organisms are identical with some previously described by Smith as *Amoeba meleagridis*; their development was studied, and found to resemble that of other parasitic flagellates which, at certain stages, have the habit of losing their flagella and becoming amœboid. They occur also in the English sparrow and other wild birds, several of which can act as hosts, and further they are found in game birds. So much damage is done that, in some districts, they constitute a severe menace to the poultry-raising industry.

SOME years ago Whitney and Means investigated the connection between the conductivity of a soil and the amount of saline matter present, and as a result of their experiments a method was elaborated whereby the percentage of soluble salts in "alkali" soils could be estimated in the field with sufficient accuracy for ordinary purposes and in a very short space of time. Thus a survey of a whole district could be made, and it was possible to ascertain the effects of irrigation, cultivation, &c., on the soluble salts of the soil. A bulletin has recently been issued by the United States Department of Agriculture giving the results of accumulated experience with the method. The writers, Messrs. R. O. E. Davis and H. Bryan, state that the method works well provided there is not too much organic matter present, and provided also carbonates are practically absent. In the former case it is better to drop the electrical method altogether, in the latter case the method can still be used, but a special set of tables is needed.

THE Canadian Department of Mines has sent us a volume, by Mr. F. Cirkel, entitled "Chrysotile-Asbestos, its Occurrence, Exploitation, Milling and Uses," which gives a very complete account of this extremely important Canadian industry. Asbestos is obtained from a relatively restricted area in the province of Quebec, but it has attained in a short time a most prominent position amongst the mineral products of Canada. The Canadian output at present is about 60,000 tons, forming about 80 per cent. of the total production of the whole world; it has practically doubled since 1904. The account now published, which is essentially a new edition of a previous report on the same subject and by the same author, issued in 1905, is a most exhaustive one, and deals very fully with all aspects of the asbestos industry, with the occurrence and distribution of the mineral, its mining and dressing, and with the subsequent manufacture of the prepared mineral into a large number of articles. Whilst, perhaps, more especially written from the commercial rather than the scientific point of view, it contains a quantity of valuable information not otherwise accessible, and should be of decided assistance to all who have to deal with asbestos either in the crude or in the manufactured state.

ON Monday, June 12, Dr. Arthur Neve, who has spent thirty years in Kashmir, lectured before the Royal Geographical Society on his journeys in the Himalayas and on some factors of Himalayan erosion. In Ladak erosion is at the present time not especially active, and the valleys are of easy gradient, but in Lower Baltistan and Gilgit rivers flow in deep gorges and have cut their way recently through immense accumulations of detritus. The rainfall is slight, and the dry, loose deposits, by their instability, are a source of considerable danger, which is greatly increased in the wet season, when vast landslips are common and rapidly alter the contour of the hillsides. Accounts were given of the damage caused by glaciers blocking up lines of drainage in such a way as occurred some years ago in the Saru valley. The lecturer's travels in the Karakorum range and the Nun Kun group in the Central Himalayas were referred to, and several points of doubtful topography were discussed. The subject of Himalayan erosion and topography were treated descriptively rather than analytically from experience gained in a long acquaintance with the region.

Le Radium for May contains a paper by M. de Broglie and L. Brizard in which their observations on the apparent radio-activity of sulphate of quinine are described. They find that the phenomena show neither of the characteristics of radio-activity—*i.e.* they are not atomic and are not independent of external influences. They have succeeded in tracing them to a thin layer of strongly ionised gas which surrounds the salt during hydration or dehydration, and they find that sulphate of chinchonine, which possesses the same phosphorescent properties as sulphate of quinine, shows the same effects. The search for other salts has not been successful. The mobility of the ions formed is of the order 1 centimetre per second in a field of 1 volt per centimetre, which shows that the ions are small. They may either diffuse slowly outwards from the layer in which they are formed or may be driven out more

quickly by an electric field. In the former case saturation currents can be obtained, in the latter the current increases indefinitely with the voltage applied. In either case the conductivity of the surrounding gas increases rapidly as its pressure is diminished.

Under the title of "First Report of the Bird Construction Committee," the Aëronautical Society of Great Britain has issued an attractive pamphlet, in which it is sought to summarise existing knowledge of the mechanical constants associated with the flight of birds. A special feature is the tabulated list of about 460 species of bird with numerical values of their wing dimensions, weights of their muscles, and similar data, compiled from the works of Harting, Marey, Moillard, Mullenhof, Legal and Reichel, and Winter. To the ornithologist, the list of Latin names with their equivalents in English, French, German, Italian, Spanish, and Russian will be exceedingly useful. Another pamphlet dealing with natural flight is Dr. Wolfgang Ritter's study of "The Flying Apparatus of the Blow-fly," published by the Smithsonian Institution (1911). For the first time in this connection, photography was used to delineate the structure of the wings and arrangement of the thoracic muscles, most of the illustrations being stereoscopic. Other figures give kymographic curves showing the movement of the wings, and serial photographs of the insect in the act of flight. Natural flight also figures in a pamphlet by Dr. Otto Wiener entitled "Vogelflug, Luftfahrt und Zukunft" (Leipzig: Johann Ambrosius Barth, 1911, pp. 60), based on the author's contributions to the *Deutsche Revue*. In addition, however, to sailing and other flight, the article deals with the influences of artificial flight in peace and war, its future effects on human progress, and other considerations of an equally general character.

OUR ASTRONOMICAL COLUMN.

The Eclipse of the Sun, April 17, 1912.—Next year's eclipse of the sun, although, under the best conditions, of very short duration, is arousing a great deal of interest owing to the proximity of the central line. It was at first suggested that a very brief totality might occur near Paris, but the slight uncertainty as to the moon's semidiameter makes this doubtful; probably it will be a very large annular eclipse there. According to the data of the *Connaissance des Temps* a six seconds' totality should occur in Spain, but according to those of *The Nautical Almanac* the eclipse will not become more than annular anywhere.

In the June number of *L'Astronomie* M. Landerer discusses the conditions for Spain, and, taking the moon's semidiameter as 15′ 31·62″, he finds that at one or two places in the peninsula an evanescent totality should occur. At El Barco (Orense) the eclipse path should have a diameter of 166 metres, and totality should last for 0·2s., so that an intending observer would have to make very sure of his position. Between El Barco and Penafiel (near Oporto) would probably prove a better station, the computed totality at the latter place being 0·4s. For Castandiello, a small village in the province of Oviedo, the computed magnitude is 0·9999, and the eclipse may easily prove total. All the places are shown on a map accompanying the article, and a special article dealing with the conditions for eclipse in France is promised in the next number.

The Changes on Jupiter, 1881–1909.—An important monograph of 180 pages discussing the features of Jupiter during the period 1881–1909 is contributed by Dr. O. Lohse to vol. xxi. of the *Publikationen des Astrophysikalischen Observatoriums zu Potsdam*, No. 62.

The observations of the various spots, bands, and other surface features of the planet are discussed individually, and the descriptions often illustrated by a sketch of the special feature made at the time of observation. Measures of the equatorial and polar diameters were frequently made with a filar micrometer, and are tabulated and discussed for each opposition. For the mean values Dr. Lohse obtains 38·343″ ± 0·059″ for the equatorial, and 36·031″ ± 0·044″ for the polar, diameter; the ratio expressing the amount of flattening is 1/16·584.

The changes in various features and many other interesting points are discussed, and the monograph concludes with twelve excellent plates, eleven reproducing drawings of the planet and the twelfth showing the normal joviographic longitudes of the Red Spot during the period 1879–1909.

Barnard's Comet, 1892 V.—The third return of Barnard's 1892 comet is due this year, and if the period lies between 6·23 and 6·52 years, as given by two of the three sets of elements prepared by M. J. Coniel, there is a chance of its being rediscovered.

To facilitate the search, M. Coniel publishes a comprehensive ephemeris in No. 4504 of the *Astronomische Nachrichten*, which is based on the assumption of a period equal to 6·37 years, and shows the places (for 1911) week by week from July 1 to the commencement of 1912.

The Motion of the Pole.—The provisional report of the results obtained by the International Latitude Service, for 1910, is published, as usual, by Prof. Th. Albrecht in No. 4504 of the *Astronomische Nachrichten*. The figure accompanying the paper shows that practically since 1906·1 the swing of the momentary, from the true, pole has been increasing; the curve for 1910·0–1911·0 encircles the previous spiral curve described since 1900·0. The x and y values (extrapolated) for 1911·0 are +0·002″ and −0·282″ respectively.

The Proper Motions of the Stars.—Several interesting conclusions are deduced by Dr. Oppenheim in a paper wherein he subjects to harmonic analysis the proper motions of the stars between declinations +38° and +65° given in the Greenwich new reduction of Groombridge's catalogue of circumpolar stars. He finds that the position of the stars into swarms along definitely directed "highways" is not finally established, and that their motions can be accounted for analytically by assuming a relative motion analogous to the geocentric paths of the minor planets, but he leaves the question of an ideal central body open (*Astronomische Nachrichten*, No. 4497).

Stellar Parallaxes.—More stellar parallaxes are given by Dr. Schlesinger in No. 4, vol. xxxiii., of *The Astrophysical Journal*. Seven stars are considered, and of these four have positive parallaxes greater than 0·1″. Among the latter, one of special interest is the well-known star Positiones Mediæ 2164, otherwise designated *Struve* 2398. The distance separating the components is now 17″, having increased nearly 5″ since the double was first measured by Struve in 1832. Recent measures show that the pair has a comparatively rapid orbital motion considering the great separation and the faintness of the components. Dr. Schlesinger finds the parallax to be +0·282″ ± 0·003″, and his results are so concordant, *inter se* and with independent determinations, that he considers that there are few stars the distances of which from us are known with so small a probable error.

Positions of Stars in the Huyghenian Region of the Orion Nebula.—As a Bulletin of the Philosophical Society (University of Virginia), vol. i., No. 4, Mr. Ralph E. Wilson publishes newly determined positions of a number of stars in the Huyghenian region of the Orion nebula. After reviewing the earlier work on the subject he gives his measures in detail; all the measures were referred finally to Bond's No. 628, but Nos. 558, 669, and 685 were also employed as fundamental stars. Six stars show what appears to be proper motion, which in the case of Bond's 612 and 618 amounts to 4″ or 5″ a century northwards. The motions of 622 and 636 can be explained by the supposition that they are physically connected with the trapezium and share its motion. In the cases of Nos. 686 and 688, the proper motions are affected by large proper motions, or Bond's positions are erroneous; observations in ten years' time would probably settle this point.

THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

T.S.S. "*Marama*,"
Pacific Ocean,
May 20, 1911.

MY last letter was very brief, as the ss. *Bouverie*, the steamer which ran on a coral reef and was subsequently got off, arrived unexpectedly at Vavau on her way to San Francisco. This meant that a mail could be sent by her, but only a short letter was written in consequence.

Although this letter is sent by the following mail to England, it happens that I am travelling in that particular mail steamer which is bound for Vancouver. We have therefore had a considerable time now to consider past events, and, incidentally, I have been down with a sharp attack of fever which I managed to pick up at Fiji; we are now three days off Honolulu, and I am convalescent.

Although during the first ten days of our stay at Vavau the weather conditions were all that could be desired for eclipse work, they gave way slowly to quite a different type; while rain had been the exception, it now became a daily occurrence, and not only did it rain, but it came down in torrents. This change of weather put quite a different complexion on our prospects. Nevertheless we worked and hoped for the best, but still the nearer the eclipse day approached the worse the weather became. On the day before the eclipse my notes regarding the weather are as follows:—"To-day would have been a bad day for the eclipse. There is a great amount of high cirrus which would have prevented good photographs from being secured, and the presence of low drifting cumuli would most probably have totally blotted out the sun for some period during totality. I expect the conditions to-morrow will be somewhat like Palma over again, but I hope the cloudy part will occur at third contact and not at second contact as it did there."

Luck was against us, however. Eclipse morning broke, and this was the cloudiest we have experienced. Cirro cumulus cloud in the form of waves extended over a considerable part of the sky, and low cumuli of various sizes were numerous. There was sufficient sun at intervals for all the instruments to be set and kept running, and I went round all the individual instruments and critically examined the definition of the solar images on the ground-glasses. Everything was most satisfactory.

I had arranged that all the working parties should be ashore at 7 a.m., and that the remainder should arrive half an hour later. The camp assumed a most business-like air, and everyone seemed glad that the day had at last arrived. I had taken the precaution to distribute parties as far apart as possible that could be distributed, and with this object I sent one party off early in the morning to take up their position on Talau Hill, 400 feet high and about three miles distant. This party consisted of observers for stars, shadow phenomena, and drawing the corona, and a small camera party. On another hill, 200 feet high and half a mile away, a second similarly constituted party was dispatched. A special party was also on board, and men placed at the mastheads.

Alas! with all these precautions no party saw the sun free from clouds. There is little doubt that, as the moon gradually covered the sun and a natural reduction of the air temperature took place, the tremendously moist atmosphere gradually condensed in the form of cloud, which became denser the nearer totality approached. Some minutes before second contact a very large black, dense cumulus with billowy tops came sweeping up from the eastward, and this cloud it was that practically sealed our doom. Onward it came, and just before second contact its outliers began to cover the sun and then totally eclipse it. The presence of the clouds made the image of the cusp very difficult to observe, as it was jumping up and down on the card. The cusp observer had eventually to give the signals from the chronometer alone.

Three whistles, two whistles, and one whistle were the signals to precede the order "go," and at "go" the whole camp began their combined effort. I fired off my first four instantaneous exposures, and then one of a few seconds, and then a long one. During this last I went out of my tent with opera-glasses and card and pencil to draw the corona, when, alas! I could not even see where the sun ought to be. The large ominous black cloud had completely blotted out the whole region. I returned to my tent very sad; at a later long exposure I emerged once more, and there was the silvery corona as rigid as an Indian order suspended in the sky. It was shorn of most of its beauty, for the cirrus cloud was very thick, and must have absorbed a great amount of light. There was no doubt about its form, however, for at a glance it represented the minimum type known as the wind vane.

FIG. 1.—Landing the Instruments.

Something extraordinary, however, seems to have happened. While the timekeeper shouted out twenty, *i.e.*

[1] Continued from p. 529.

FIG. 2.—In the early stages of the erection of the Instruments. View taken from a Cocoanut Tree.

FIG. 3.—A General View of the Eclipse Camp. Camera facing nearly West.

there are twenty seconds left, the sun burst through! The eclipse was over!

Being busy with my instrument at the beginning of totality, and not being able to see the sun because of the roof of my tent, I could not observe whether totality began with the word "go." A consultation with my *confrères* afterwards soon gave me the information I was seeking. The eclipse began fully twelve seconds before the word "go" was given, and finished twenty seconds before the word "stop" was shouted. This very considerable difference between calculation and observation seems at present unexplainable, but similar, or nearly similar, times were recorded by the other parties at Neiafu.

In addition to three chronometers, regular transit observations had been daily made with the transit that was set up on a concrete pillar in our camp. The ship's chronometers were also in very close agreement with those we brought out, so there could be no error of any magnitude regarding the time. This important matter will be cleared up when Mr. Brooks, who has the matter in hand, sends in his report on the subject.

The eclipse being over, I called my party together, and we gave three cheers for the captain, officers, and men of H.M.S. *Encounter* for the magnificent assistance they had rendered on the occasion of this eclipse. It was most disappointing that the weather had been so unfavourable, for had it been otherwise we should have gathered a wonderful harvest of valuable solar data.

While we were so hard dealt with at our station, the Australians at Neiafu, about a mile from us, suffered nearly the same experience. They watched the approach of the large cloud, and thought that it would affect them and not us—it affected both of us, however, with disastrous results. A hundred yards or so distant from the Australian camp was that of Mr. Worthington and his party. He seems to have been wonderfully lucky, for in spite of all the clouds about, a rift in them enabled him to secure some beautiful photographs of the corona, as good as the best photographs that have ever been taken during an eclipse. I have not seen the negatives myself, but everyone who has is most enthusiastic about them.

On development of the photographs of my party, the useful results are very meagre. No record at all was shown on the large films of the large grating spectrograph worked by Mr. McClean. On the 6-inch prismatic camera plates one plate may be very useful. This plate was closed at twenty seconds according to the eclipse clock, *i.e.* was closed about half a second after third contact. All the chromospheric large arcs are well shown, and a great number of short bright arcs, showing that a record of the chromosphere was secured. There is a certain amount of continuous spectrum shown on the plate, but the spectrum is rich in lines in the violet end. A plate exposed immediately after this gives a dark-line spectrum. Several of the coronographs show images of the corona sufficiently good to enable the general form of the corona to be deduced, but they all show too much cloud. The 4-inch 16-foot coronograph has perhaps the best record of the lower corona, and this is beautifully sharp and gives a very fine photograph of the large prominence, the most conspicuous object just before third contact.

FIG. 4.—The Captain and his two time callers at the Eclipse Clock.

The above practically sums up the results of the expedition from the astronomical side. In other directions we have positive results. Thus a fine series of observations made with the self-recording barograph, thermograph and hydrograph have been secured. A very complete collection of botanical specimens representing the wild flowers, ferns, &c., and numerous seeds, of the island will, I hope, prove useful.

An excellent collection of butterflies and moths representing most of the varieties has been made, and we are bringing home numerous pickled specimens of fish, centi-

pedes, lizards, ants, scorpions, &c. Geological specimens were not numerous, but what there were were secured. A large number of specimens of shells and different varieties of coral were also collected.

The day following eclipse day, a Sunday, it rained steadily from morning until night. The camp became a hopeless morass; every tent was saturated through and through, and most of the contents as well. Fortunately, packing up had been commenced directly totality, of the day before, had finished, and by the evening the greater portion of all the instruments were safely housed away in their packing-cases in the instrument tent. Fortunately, again, I had had the floor of this tent covered with thick rafters to keep the cases off the ground, and if it had not been for this precaution the cases would have been thoroughly soaked. The rain therefore did little damage. We filled as many barrels as we had with the water from the awnings, and this came in extremely useful for the dark-room during the subsequent days spent in developing and making copies.

I had two special boxes made on board the ship to carry the original negatives, and the copies and one box will go home with the rest of the packing-cases, while the second will be dispatched later by a different steamer to England.

On May 3 the ss. *Tofua* arrived at Vavau on her way to Sydney, and I boarded her to inquire from her captain what he had seen of the eclipse. Captain Halford had stopped his ship right on the central line, and they viewed the eclipse in a cloudless sky. Several drawings which were made on board were shown to me, and they all indicate similar appearances, namely, equatorial extensions and rifts at both poles. Shadow bands were very conspicuous, and a great number of stars were logged. The captain kindly had a copy of his observations made for me, as I wished to compare the times of his contacts with those observed by us.

In the evening the *Tofua* left with all the eclipse parties except those going by the *Encounter*.

The next morning the *Encounter* weighed anchor from the spot where she had remained so long. I think we were all very glad to get away. If we had had a successful eclipse we might have severed our connection with a pang of regret. There were no regrets. We had worked hard and been treated very badly, and some of us, myself included, hoped we should never see the spot again. Out of the little harbour we steamed, stealing away before the inhabitants were up. One by one we passed the thickly tree-covered islands, and at last we came to the open sea and the cooler air, leaving the pests of flies and mosquitoes behind us. Oh those flies and mosquitoes; they were the curse of the island!

The *Encounter* being now bound for Suva, Fiji, to coal, and land Mr. McClean and myself, our course was shaped for that island. In order to make all land by daylight, a six hours' stop was indulged in off Late Island. This island is on the western outskirts of the Tonga group, and is nothing but a large volcano. With difficulty a landing was made, and while one party, including myself, started out to climb to the crater, another party went to shoot pigeon and pig. Incidentally, I made a good botanical collection, and gathered numerous specimens of seeds. On our return to the shore the tide had gone down, and the pools in the lava were full of the most beautiful coral fish and snakes, weird in colour and shape, that one could desire. An exciting return to the boats ended quite a successful day's adventure. The next day was spent at sea, and we sighted Suva on Saturday morning (May 6). Being "Accession" Day, the ship was dressed as the anchor was let go.

Mr. McClean, Mr. Anderson and myself took up our quarters at this port to await our ship, the t.s.s. *Marama*, which was to take us to Honolulu. On May 11 H.M.S. *Encounter* steamed gracefully out of the harbour on her way to Sydney, and it was sad to see her go without us, for both officers and men had become quite endeared to us. However, it had to be, and we watched her until nothing more than smoke was visible.

At Suva there was little to be done, as it was very hot, but there were no flies and very few mosquitoes, so we might have been worse off. On May 13 we drove to Rewa, a distance of twelve miles, and then took a motor-boat up the fine river Rewa, the upper reaches of which are very beautiful. To me this trip was disastrous, for next day I was laid up with fever. On May 15 our steamer, the *Marama*, bound for Honolulu and Vancouver, arrived, and we boarded her and sailed the same evening. At the moment of writing (May 21) we are now two days off our destination, and we are indulging in the cool N.E. trades after the stillness of the doldrums.

After Honolulu we are bound for the States, where I hope to see first hand the chief American astronomical observatories. We are due in England about July 11, when we shall have completed a most interesting circuit of the earth. We shall have gained one day!

W. J. S. LOCKYER.

A NEW ROD OF AARON.

THE naturalist and the physiologist have been well acquainted for several years with the results achieved by Loeb, Delage and others, in the way of causing the eggs of various animals to develop by chemical and other purely physical means, apart altogether from the agency, direct or indirect, of the male animal; but these astonishing experiments are still very little known to workers in other sciences. Before directing attention, as is the object of this short note, to the last and perhaps the most startling of all such experiments, it may be worth while to say a few words on the general question.

The subject seems to fall under two heads, namely, artificial means of facilitating the action, or of widening the sphere of action, of the male element, and, secondly, means of dispensing with it altogether and of replacing it by some wholly artificial stimulus.

In Loeb's early experiments he showed that, while under normal conditions the eggs, for instance, of a sea-urchin could not be cross-fertilised by the sperm of a starfish, yet by simply rendering the surrounding sea water faintly alkaline, a new condition was established in which the sea-urchin's eggs were capable of fertilisation by the sperm-cells of any or every species of starfish, and by certain other alien species of echinoderms besides, while, at the same time, in this more alkaline sea water the sperm of the original sea-urchin had actually lost the power of fertilising the eggs of its own species.

More than five-and-twenty years ago it had been shown, by Tichomiroff and others, that the eggs of the silkworm could be caused to develop "parthenogenetically" by simple mechanical stimulation, such as brushing, or by chemical treatment, as with sulphuric acid. But these results attracted less notice than they should have done, partly, perhaps, because in other insects parthenogenesis, or the development of unfertilised eggs, was known to occur under natural conditions, as in the case of greenflies or plant-lice (Aphides), or in the case of the drone-progeny of the queen-bee.

Passing over various intermediate experiments, we come to those which Loeb published in 1904, in which he showed that, if the eggs of a sea-urchin be put into sea water to which has been added a little formic, acetic, butyric, or other fatty acid, and then after a minute or two be put back into ordinary sea water, they begin to show the initial changes characteristic of nuclear division. But if, on the other hand, they be transferred from the acidified sea water to sea water the concentration of which is increased by a suitable addition of common salt, then the whole cycle of development proceeds just as though normal fertilisation had taken place, and the highly complicated free-swimming larvæ are produced in unlimited numbers and in the same manner and at the same rate as in the ordinary course of sexual development; and if the experiment has not been carried further, to the complete post-larval development of the entire sea-urchin, it must be remembered that the artificial feeding and rearing of this and other marine animals beyond a certain stage, even from normal and fertilised eggs, is a matter of the very greatest difficulty. Precisely similar experiments have been successfully performed by various workers on marine worms and molluscs, and a few years ago Bataillon showed that even the eggs of the lamprey could be induced to segment by simply placing them in water of a certain

degree of salinity. It is impossible to discuss here the various theories of fertilisation to which these astonishing experiments have given rise.

But such phenomena appear, perhaps unreasonably, all the more astounding to us, as the animals experimented on are higher in the scale; and so we may look with renewed wonderment at a phenomenon which M. Bataillon has demonstrated in the frog, and M. Henneguy has repeated and confirmed.[1] Eggs were taken from the body of a female frog, under proper antiseptic precautions and with careful simultaneous "control" experiments. The eggs were placed in a little dish, and were then carefully pricked with a tiny needle of platinum or a sharp spicule of glass, after which they were covered with a layer of water sterilised by heat. In the hands of these physiologists, the little needle was as potent (or almost as potent) as Aaron's Rod. In about four hours the eggs began to develop, but while all of them passed through some initial stages, it was about one-fifth only that segmented in the normal way. At every stage the mortality was greater than in the case of ordinary fertilised eggs, but at length, out of a thousand eggs experimented on, one hundred and twenty hatched into tadpoles, and of these three were reared through parts of their metamorphosis. They did not actually turn into frogs, but died accidentally or for want of proper nourishment after the appearance of their legs, and after the oldest (about three months old) had all its four legs well developed and its tail already beginning to disappear; it was, in short, all but a perfect frog. As with St. Denis, when he walked a short distance with his head under his arm, "ce n'est que le premier pas qui coûte"; but these tadpoles, if they did not endure to the end, went a long distance on their way.

It is all but superfluous to add that the authors of these researches are men of high standing and reputation, skilled in all the precautions necessary for the carrying out of their experiments and for safeguarding them from all sources of accidental error. In short, we may have no doubt at all that what they assert they have actually performed—that they have demonstrated the artificial fertilisation of a vertebrate ovum by a simple mechanical stimulus, and that, so to speak, they have raised a hybrid between a needle and a frog! But here we are face to face with the double *rôle* which the male plays in the process of fertilisation, for, on one hand, it is his part to give the initial impulse or stimulus to the act of development, and on the other to convey to the offspring a share of his own hereditary qualities or characteristics. In these artificial experiments of parthenogenesis the two influences are dissociated. The former one is efficiently replaced by chemical or mechanical means, but the other drops out of sight altogether. For, as a French critic has remarked, "il ne peut être question d'hérédité du côté du père, car on ne voit pas très bien les jeunes grenouilles héritant des propriétés de leur épingle paternelle"!

D. W. T.

AGRICULTURAL RESEARCH IN CEYLON.[2]

THE staff of the Royal Botanic Gardens, Ceylon, show commendable activity in investigating the planters' problems that come under their notice. At frequent intervals issues are made of the Circulars and Agricultural Journal containing their papers, which will be found to bear comparison with any publications from other experiment stations. These papers show an obvious mastery of the situation, they are conceived in a scientific spirit, and exhibit none of the looseness characteristic of amateur investigations into agricultural questions. Tea and rubber naturally come in for a good share of attention, but other crops also present their problems, many of them of considerable interest and importance.

As usual in subtropical countries, most of the problems are connected with insect and fungoid pests, and half of the present batch of publications are from the mycologist, Mr. T. Petch. Five root diseases of tea caused by fungi are described. The commonest is caused by *Ustulina zonata*, Lév.; the dead tea roots show no external mycelium, but only a few inconspicuous black spots; if the cortex is removed, however, white fan-shaped patches of mycelium are found overlying the wood. The starting points of the disease are usually the dead stumps of Grevillea, which is grown among tea, and cut down either for firewood or when it has grown too large. Another common disease is caused by *Hymenochaete noxia*, Berk., a fungus that attacks numerous other plants. Here the mycelium is external to the root, and binds up a mass of sand, earth, and small stones, thus forming a crust 3 or 4 mm. thick; in the early stages the mycelium is brown, whence the name brown root disease has been given; later on, however, the whole turns black. It is the commonest root disease of Hevea in Ceylon, but does less damage than *Fomes semitostus*; unlike the latter, it does not spread through the soil, but only along the roots of trees; hence its progress is so slow that, as a rule, the first affected tree is dead before the neighbouring trees are attacked. Another root disease of Hevea, so far uncommon, is also described. It is caused by *Sphaerostilbe repens*, B. and Br., and is characterised by the black or red flattened strands running over the surface of the wood after the cortex is removed, there being no external mycelium. *Acacia decurrens*, which has been extensively planted as a wind-break for tea or for green manuring, and for more than thirty years seemed immune from disease, has now been found to suffer from two root diseases in addition to a "gummosis," the cause of which is not yet ascertained. An agaric, *Armillaria fuscipes*, causes one root disease, and *Fomes australis* the other. Another publication deals with canker in cacao and hevea. The latter plant does not usually suffer from canker when grown alone, but it is badly affected when grown in mixed plantations with cacao, which serves as a permanent source of infection. It is concluded that both canker and pod diseases are caused by *Phytophthora faberi*, Maubl.; complete examination was, however, made of the other fungi also present.

Mr. E. E. Green describes the extraordinary outbreak of snails, *Achatina fulica*, that has occurred in part of the island, and to which reference has already been made in these columns. This snail is large, its shell being about 4½ inches long, and weighs about 4 oz. It has only recently been introduced, but it has not effected nearly so much damage as might have been expected, because it feeds on human and cattle excreta; indeed, Mr. Green considers that, on the whole, it is doing more good than harm, and does not recommend any drastic attempts at extermination. Before long the natural enemies will keep it down.

Messrs. Kelway, Bamber, and R. H. Lock give a preliminary account of their studies on the effect of different intervals between successive tappings in Para rubber. A previous investigator, Parkin, obtained an increase of more than 600 per cent. of latex by increasing the frequency of tapping; Bamber and Lock, on the other hand, find no such marked wound response, although they advise frequent tappings from the practical point of view.

The official correspondence with regard to cotton-growing in Ceylon is also published. Dr. Willis does not think there is much future for the crop; other products yielding larger profits are not likely to be displaced. There is also a useful account of various samples of Cymbopogon grass oils prepared by Mr. Jowitt, of Bandarawela, and examined at the Imperial Institute.

ABSORPTION SPECTRA OF METALLIC SALTS.[1]

THE present volume is designed as a continuation of the work of Jones and Uhler and Jones and Anderson, and gives the results of a detailed study of the absorption spectra of salts of potassium, cobalt, nickel, copper, chromium, erbium, praseodymium, neodymium, and uranium, as affected by various chemical reagents and different temperatures. For the purpose of the discussion some 3000 solutions have been examined. The main points

[1] "L'embryogénèse complète provoquée chez les Amphibiens par piqûre de l'œuf vierge," etc. Par E. Bataillon. C.R., Avril 13, 1910, Arch. de Zool. exp. et gén. (5), vi, Nov. 1910; C.R., 27 Mars, 1911.
"Sur la parthénogénèse expérimentale chez les Amphibiens." Par F. Henneguy. C.R., Avril 3, 1911.

[2] Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon. Vol. v.

[1] "A Study of Absorption Spectra." By H. C. Jones and W. W. Strong. Pp. ix+159+98 plates. (Washington, D.C.: The Carnegie Institution, 1910.

of investigation have been the effects of the addition of free acids and foreign salts on the absorption spectra. A notable result is the discovery of well-defined "solvent bands" for various substances, for example, water, alcohols, acetone, glycerol, which do not show any appreciable absorption of visible light.

In general it is shown that the *anions* of the various coloured salts play a much less important *rôle* in modifying the spectra than the solvent. Different salts of the same anion in the same solvent usually have the same absorption spectra. As, however, the absorption spectra of the powdered salts may be very different, it is evident that the solvent has an important part in the mechanism of absorption.

On the other hand, the absorption spectra of the same salt in different solvents are often very different; Jones and Anderson have ascribed this to the formation of *solvates*, more or less stable compounds of the salt and solvent. The persistence of solvent bands varies quite widely for the different solvents, appearing to be greatest for water and less for the alcohols.

Some of the uranous salts in the various solvents, water, alcohols, acetone, and glycerol, show characteristic bands very strongly. An attempt is being made to correlate many of these well-defined phenomena with the results of the Zeeman effect on similar variations of the salts and solutions, and it is considered that the results of such investigations may lead to a much clearer knowledge of the chemistry of compounds. In some cases it is possible to break up the absorption bands into very fine bands by chemical methods, as has been done with uranyl and uranous salts in acetone solutions, the most marked example being the action of hydrochloric acid on an acetone solution of uranous chloride.

A very noticeable result is the action of free acids on the corresponding uranyl salt, *e.g.* acetic acid on the acetate, nitric acid on the nitrate, &c. In most of these cases the presence of these foreign reagents causes the uranyl bands to become more intense, and, in most cases, narrower. The action of all except nitric acid is to cause the uranyl bands to be shifted towards the red. Nitric acid, on the contrary, produces large shifts towards the violet. A very important result of this analysis is that the absorption bands gradually shift as one salt of a metal is transformed into another by the addition of free acid. This is interpreted to mean that a series of intermediate products are formed, each with its characteristic absorption spectrum, although the chemical methods at present at our disposal do not enable us to isolate them.

It is also shown that rise in temperature causes the general absorption of any salt in water to increase, and the bands to broaden and become more intense.

The authors summarise the discussion as to the bearing of this work on the solvate theory of solution.

An excellent series of ninety-eight photographic reproductions of the spectra is included in the volume.

C. P. B.

THE ROYAL SOCIETY CONVERSAZIONE.

THE ladies' conversazione of the Royal Society was held at the rooms of the society in Burlington House on Wednesday, June 14. Many objects and experiments of scientific interest were on view, but most of them were described in our account of exhibits at the previous conversazione on May 10 (NATURE, May 18, p. 394). It is unnecessary, therefore, to refer to these again. Among other exhibits at last week's function were those described in the subjoined summary of the official catalogue.

The Director, Khedivial Observatory, Helwan, Egypt.—Photographs of Halley's comet, taken with the 30-inch Reynolds reflector by Mr. H. Knox Shaw. The photographs exhibited cover the period from April 16, 1910, to June 10, 1910. *Royal Astronomical Society.*—Photographs of the planet Mars, taken by Prof. E. E. Barnard with the 40-inch telescope of the Yerkes Observatory. The photographs of September 24, 1909, show the region of the Fastigium Aryn and Margaritifer Sinus, and those of September 28 the region of the Syrtis Major.

The Director, Royal Botanic Gardens, Kew.—(1) Collection of Euphorbias, showing mimetic resemblance. The following species of Euphorbia, selected from the collections at the Royal Botanic Gardens, Kew, show remarkable resemblance in habit to plants of other natural orders to which they are in no way related botanically. The species of Euphorbia, together with the plants they resemble, were exhibited side by side.

(1)	*Euphorbia Berthelotii*	*Cotyledon lineolare.*
(2)	,, *colletioides*	*Rhipsalis micrantha.*
(3)	,, *dendroides*	Willow twigs.
(4)	,, *hystrix*	*Cereus insularis.*
(5)	,, *Intisy*	Prunus twigs.
(6)	,, *polygona*	*Cereus polygonus.*
(7)	,, *Schimperiana*	*Ceropegia fusca.*
(8)	,, *Sipolisii*	*Vitis quadrangularis.*
(9)	,, *stapelioides*	*Stapelia micrantha.*
(10)	,, sp.	Pelargonium sp.
(11)	,, *Tirucalli*	*Senecio junceus.*
(12)	,, *xylophylloides*	*Epiphyllum truncatum.*

(2) *Ficus Krishnae. F. Krishnae*, a remarkable species most nearly allied to *F. bengalensis*, in which the leaves are cup-shaped, the inside of the cup being formed by the under surface of the leaf. *Mr. W. Fawcett.*—A parasitic flowering plant from Jamaica (*Scybalium jamaicense*, Schott and Endl.). This species is one of the Balanophoraceæ, a family of parasitic flowering plants growing on the roots of trees in tropical forests. They do not develop chlorophyll, and are therefore altogether dependent upon their host for sustenance. The seed contains an embryo of the simplest structure, having neither cotyledons nor radicle; it germinates in the soil, the embryo grows in length, thread-like, until it touches the root of a tree, and then penetrates it. When established on the root it forms a tuberous rhizome, from which flowering stems are produced. The flowers are very small, numerous, in heads on a stalk covered with scales—male and female flowers on distinct heads. This species is found in Jamaica, Cuba, and Hispaniola. Other species occur in Brazil and Colombia. *Mr. P. S. U. Pickering, F.R.S.*—Germination of seeds in heated soil. When soil is heated there is formed in it a substance toxic towards the germination of seeds and the growth of plants. Seeds germinate more slowly and in smaller proportions the higher the temperature of heating up to 250°. By exposure to air and moisture the toxic substance is destroyed. Plants grown rapidly in previously heated soil also show the presence of a toxic substance, but after this has become decomposed, such soil, owing to increased soluble contents and altered bacterial conditions, promotes plant growth.

Dr. G. H. Rodman.—A series of stereoscopic transparencies illustrating the life-history and minute structure of the stick insect (*Bacillus rossi*). Stick insects are natives of warm climates (India, Australia, the Malay Peninsula), but with care they may be reared in this country. They resemble, as their name suggests, portions of stick, and they afford an excellent example of mimicry. The various stages during the escape of the insects from their eggs are shown. The feet are provided with a pair of sharp hooks, by which they can cling to rough surfaces, and also with a pad or sucker, which enables them to get a foothold on perfectly smooth surfaces. The eye is a compound one, and faceted. They stand prominently out from the surface of the head, and are covered at will by the insect extending his forelegs directly forward in the long axis of his body. The skin is cast several times during the growth of the insect. It is shown that the antennæ and surface of the eyes share in the desquamation of the insect. *Dr. Francis Ward.*—(1) Photographs of fish life, as seen from below the surface of the water. (2) Photomicrographs of the growth of larval fish (plaice) taken from life. The photographs are taken in a pond specially constructed for the purpose. In one wall of the pond is a large open space which communicates with an observation chamber, and between this chamber and the water in the pond is a sheet of plate glass. Concealed in the chamber, the observer can watch the fish as they appear to each other in the water. In consequence of the darkness in the chamber and the light in the pond, the glass acts as a mirror, and the fish merely sees himself and his surroundings reflected, while the observer can plainly see into the pond. It is thus possible to observe a timid fish without disturbing him. In addition, an instantaneous

photograph can be taken at 1/250th of a second. *Dr. W. N. F. Woodland.*—Microscopic preparations and a model illustrating the mechanism employed in the production of the oxygen used to inflate the gas bladder of bony fishes. Most fishes employ oxygen (usually also nitrogen and carbon dioxide) for the inflation of the gas bladder (incorrectly termed "air" and "swim bladder") when this is present. The presence of oxygen is associated with the power of producing relatively rapid variations of the quantity of gas in the bladder, a power required in deep-water fishes which sink and rise, and so experience considerable changes in external pressure. A special gland, the oxygen gland ("gas gland"), and an equally important and very remarkable supplementary apparatus, the rete mirabile duplex, are developed in the bladder wall for the special purpose of producing the oxygen. The reason why oxygen is the gas employed for the inflation and deflation of the bladder is because of its abundance in the blood stream and the facility with which it is dissociated from (the red blood corpuscles undergoing disintegration for the purpose) and reassociated with the hæmoglobin of the blood.

Miss Dorothy Bate.—(1) Fossil remains of the peculiar goat-like animal *Myotragus balearicus*, Bate, from Majorca. (2) Photographs of the locality and caves in which the bones of Myotragus were found. Nothing is known of the habits or origin of this peculiar animal, which formerly inhabited Majorca in large numbers. Myotragus differs from all other goats, sheep, and their allies in having only two lower front teeth, which are very large and are modified to form a sharp chisel-edge; they grow continuously, like those of a gnawing animal such as the rat or rabbit. It is also remarkable for the shortness and stoutness of its metacarpals and metatarsals, the latter being usually united to the distal row of ankle bones. *Dr. C. W. Andrews, F.R.S.*—Remains of Tertiary mammals from near Lake Victoria Nyanza, British East Africa. The specimens shown are the first remains of Tertiary mammals from Central Africa. They are portions of the lower jaw with teeth, and a calcaneum of a small species of Dinotherium, which is very similar to *Dinotherium cuvieri* from the Lower and Middle Miocene of France. The age of the African beds is not yet definitely known, since it is possible that Dinotherium may have survived in Central Africa long after it had become extinct elsewhere. The specimens were obtained through Mr. C. W. Hobley, C.M.G., Commissioner of Mines. *Mr. G. C. Crick.*—Models of shells of extinct cephalopods. The models represent the shells of three cephalopods which lived in the Silurian seas and possessed chambered shells like that of the living pearly nautilus, but differed therefrom, among other characters, in the contracted form of the aperture of the body-chamber. *Mr. C. Forster-Cooper.*—Part of a collection of fossil mammals from the Lower Miocene beds of Dera Bugti, Baluchistan. (1) Jaw of a specialised type of primitive Rhinoceros; (2) separate lower incisor of primitive Rhinoceros; (3) portion of cranium of primitive Rhinoceros; (4) upper molar tooth of primitive Rhinoceros; (5) astragalus of primitive Rhinoceros; (6) mandible of Aceratherium, sp.; (7) teeth of mastodon, sp.; (8) upper teeth of Rhinoceros; (9) upper and lower teeth of an Anthracothere; (10) portion of a mandible of an anthracothere.

Nubian Archaeological Survey.—Objects found in the area to be submerged on the raising of the Aswan Dam. (Exhibited by the late Director-General of the Survey Department of Egypt, Captain H. G. Lyons, F.R.S., and the present Director-General, Mr. E. M. Dowson, on behalf of the Egyptian Government.) (1) Decorated pottery and other objects of the early dynastic period in Nubia (Dynasties I. and II. in Egypt, *circa* B.C. 3000), at which date Nubia was occupied by the Egyptian race. The hand-made pottery differs from that of the same period in Egypt in form and decoration, possibly owing to the geographical position of Nubia and to the rarity of stone vessels, the manufacture of which appears to have checked the development of fine hand-made pottery for funerary purposes in Egypt. (2) Decorative pottery and other objects illustrative of the non-Egyptian culture of the race (C group) which occupied Nubia from about the close of the old kingdom until it was expelled or absorbed by the military expeditions of the twelfth dynasty and the Egyptian colonies of the early new Empire. The incised pottery and steatopygous dolls show marked analogies with similar objects of the pre-dynastic Egyptian period of nearly 2000 years before.

Mr. Albert Bruce-Joy.—Bronze statue of the late Lord Kelvin by Mr. Albert Bruce-Joy, to be placed in Belfast. The likeness represents Lord Kelvin as he appeared about twenty years ago. The statue will ultimately be placed on a granite pedestal.

SHELL-FISH AND THEIR RELATION TO DISEASE.[1]

THE connection between the consumption of edible shell-fish (molluscs) and certain diseases, in particular typhoid or enteric fever, has in recent years attracted the attention of epidemiologists, and several valuable contributions on the subject have been published in this country. In 1894 Dr. Bulstrode reported to the Local Government Board on "Oyster Culture in Relation to Disease," in which he concluded that there remains "much to be done before the public can consume oysters, bought promiscuously, with a reasonable degree of safety." The danger of oysters was again brought home to the public by the outbreaks of enteric fever following banquets at Winchester and at Southampton in 1902, on which Dr. Bulstrode also reported.

Cockles and mussels have likewise been implicated in the dissemination of enteric fever in and about London and elsewhere.

The matter has assumed such importance that a further report on the subject by Dr. Bulstrode has been communicated to the Local Government Board, and brings up to date and extends our knowledge of the relationship between the consumption of shell-fish *other than oysters* and the occurrence of disease among those consuming the shell-fish. The molluscs of chief importance are cockles and mussels, and the beds are found all round our coasts, particularly in the estuaries of rivers, which are frequently liable to sewage pollution; but a part of the supply is obtained from abroad, America and Holland chiefly. In the report, the distribution of the shell-fish is shown on maps, and also the relation of the beds to the neighbouring sewer outfalls. The possibility of contamination is critically surveyed from a consideration of all the local factors, for the proximity or otherwise of a sewage outfall to a bed does not necessarily imply contamination or purity respectively; much may depend, for instance, on tidal conditions, on the absence of water at low tide, on the period at which the sewage is run out, &c. Again, even if the shell-fish beds themselves are remote from sources of pollution, the shell-fish may be brought to polluted waters for cleansing or storing, and several examples are given of this in the report. Bacteriological investigations have been excluded from the report, because it was considered that the topographical test would, on the whole, afford the least conflicting evidence.

Although shell-fish such as cockles are cooked before use, the "cooking" is often a very perfunctory affair, and by no means sterilises. At Leigh-on-Sea, however, owing to definite proof of the conveyance of enteric fever by the fish, the cockle merchants have provided forms of sterilisers or autoclaves in which the fish are exposed to steam under pressure. In the coppers in which the cockles are ordinarily boiled, while the bottom layers may be sterilised, the upper layers very often certainly are not.

The epidemiological evidence connecting the consumption of shell-fish with the subsequent occurrence of enteric fever or gastro-enteritis is detailed in chapters vi.–x. of the report. While in numerous instances it has been possible to connect the consumption of shell-fish with a subsequent direct outbreak of enteric or gastro-enteritis, it is more difficult to connect a part of the ordinary and sporadic incidence of these diseases with the general con-

[1] Report on Shell-fish other than Oysters in relation to Disease. By Dr. H. Timbrell Bulstrode. Pp. viii+243. Supplement in continuation of the Report of the Medical Officer. Thirty-ninth Annual Report of the Local Government Board, 1909–10; (London: Wyman and Sons, Ltd.; Edinburgh: Oliver and Boyd, Dublin: E. Ponsonby, 1911.) Price 8s.

sumption of shell-fish. The evidence marshalled by Dr. Bulstrode for this connection must, however, go a long way to dispel any doubt, if such exist, of its reality. The evidence, of course, is largely indirect, and comprises such details as these: the greater incidence of enteric among those who eat shell-fish than among those who do not; diminished incidence of enteric coinciding with diminution in the amount of sewage emptying into estuaries, &c.; the "cooking" of shell-fish diminishing the incidence of disease; reduction in enteric fever prevalence coinciding with limitation of the consumption of shell-fish; and (sometimes) seasonal variations in the shell-fish supply coinciding with seasonal variations in disease.

Finally, one of the most important parts of the subject, the administrative control of contaminated shell-fish, is dealt with. The difficulties in this direction are very great. Ineffective efforts at legislation have been made, and, failing success, the authorities concerned have fallen back on the publicity secured by local posters, &c., which, of course, affects the sale of wholesome, as well as of unwholesome, shell-fish. The Fishmongers' Company and several corporations have done excellent work, and one or two local Acts have been obtained (*e.g.* by the Corporation of Blackburn in 1908) to deal with the matter, but otherwise practically no control, in a sanitary sense, has been exercised over the beds, laying, and cleansing and storing places. Probably the local application, as required of the powers contained in the Public Health (Regulations as to Food) Act, 1907, would generally suffice.

The whole report is a very valuable one, and should arouse public attention to the necessity for taking definite action to deal with the subject of the contamination of shell-fish. The report is prefaced by a lucid introduction by Dr. Newsholme, the Board's medical officer, from which we have drawn freely in writing the above.

R. T. H.

THE CHEMISTRY OF MUMMIFICATION.

MR. A. LUCAS has rendered a great service to all who are interested in the customs of the ancient Egyptians and in the history of the methods adopted for the preservation of the body by collecting into one convenient volume the results of his investigations concerning the "Preservative Materials used by the Ancient Egyptians in Embalming," which has been issued as Survey Department Paper No. 12 (Cairo: National Printing Department, 1911).

More than seventy years ago Dr. Pettigrew published an exhaustive account of the chemistry of mummies, so far as this was possible at that time, and he had the assistance of Michael Faraday in his investigations. Since then the whole subject of mummification had fallen into the hands of archæologists, who invented a curious alchemy of their own for the purpose of interpreting the accounts of Egyptian embalming given by the ancient Greek writers; but during the last ten years this era of sensationalism has received its quietus, and a serious attempt has been made to elucidate by recognised scientific means the nature of the methods of mummification.

Recent investigators have had the immense advantage of having many hundreds of mummies of known age and provenance for every unknown mummy that came into Pettigrew's hands; and the enormous strides in chemical knowledge that the last seventy years have witnessed have made it possible to obtain much more information from the material than was possible before. Most of the embalming materials thus rescued have been analysed by Prof. W. A. Schmidt, of the Cairo School of Medicine, and Mr. Lucas, analyst to the Egyptian Survey Department, and the results of their work have been published in various scientific journals published in Egypt and Europe. Mr. Lucas has collected all this scattered information and added to it in this valuable report. He has also given an extensive bibliography, which, though not quite complete, will be of very real service to archæologists, who in the past have been at a loss to obtain accurate information upon such matters as are discussed in this work.

AN IMPERIAL BUREAU OF ANTHROPOLOGY.

WE print below a memorial relating to the formation of an Imperial Bureau of Anthropology, received from the Royal Anthropological Institute. The memorial was sent a few days ago to the secretary of the conference, to Mr. Asquith and each of the other Prime Ministers, and to the Colonial Secretary. Though the matter did not appear on the agenda of the Imperial Conference, we learn that the individual members of the conference are cognisant of the facts, and one or two are desirous of obtaining more information. We trust it will be possible for some action to be taken on the lines suggested by the memorial.

Memorial on the Establishment of an Imperial Bureau of Anthropology presented to the Imperial Conference by the Royal Anthropological Institute.

The Council of the Royal Anthropological Institute desires to submit the following facts for your consideration:—

(1) An important and an integral portion of the problem of Empire is that which is concerned with the relations of the Imperial race with dependent peoples whose history, religion, social structure, and habits of life and thought are far removed from ours.

(2) The social characteristics of the dependent races are being profoundly modified by contact with our civilisation, and experience has shown that habits of life and thought, the products of long ages, have a tendency to disappear under modern conditions.

(3) The council urges, also, that on administrative grounds an exact and an intimate knowledge of the mental attitudes and modes of life of these races is essential to those whose duty it is to govern them.

(4) As the body representing the premier scientific institution in Great Britain whose object it is to promote the organised study of mankind, the council is much concerned with the inevitable loss to science consequent on the extension of our civilisation; but the manners and customs of many semi-savage tribes in the Empire still survive, and are worth the serious attention of the scientific anthropologist. It urges, therefore, that the resources of modern science should be thoroughly and systematically employed in order to record those customs which are of such value and interest to the student of anthropology.

(5) Another important problem of Empire is the physical improvement or deterioration of all the races of the Empire. This can only be ascertained by periodic measurement of children and adults. It is obvious that this work must be controlled from a single centre in order to secure uniformity.

(6) The council desires to point out that the scientific study of anthropology at the universities has made great and marked progress in late years, a gratifying fact which is due in no small measure to the efforts and example of distinguished fellows of the Royal Anthropological Institute.

(7) The number of trained investigators is steadily increasing, and every year sees an advance in the accuracy and thoroughness of the methods of anthropological investigation.

(8) While it is the duty of the universities to organise the study of anthropology, it is the task of the Royal Anthropological Institute to coordinate all branches of that study by the exercise of functions in regard to it analogous to those performed for science in general by the Royal Society.

(9) In these circumstances the Council of the Royal Anthropological Institute seeks the support, moral and financial, of your Governments for a scheme to establish in London, in association with the institute, an Imperial Bureau of Anthropology, in order to secure the systematic investigation by scientific methods, according to a uniform plan, of the anthropology of the dependent and independent races within the British Empire.

(10) The council recognises that this project can be carried to success only if local cooperation and support be freely accorded to it. The methods and procedure of investigation very often must be adapted to local necessities of which the investigator on the spot is alone competent to judge. But it is clearly desirable that within limits there should be uniformity of method for the sake of the com-

parison and collation of the results garnered in so many parts of the Empire.

(11) The council therefore proposes (*a*) that there should be established in London an Imperial Bureau of Anthropology; (*b*) that the bureau should be managed by a committee constituted of the Council of the Royal Anthropological Institute, and containing representatives of the Governments of the British Dominions, of the India and Colonial Offices, and of those Universities in Great Britain, in India and the Colonies and Dependencies of the Empire where anthropology is systematically studied.

(12) The council further proposes that in each of the British Dominions, in India and in the Crown Colonies, there should be established local committees on which the local university or universities and scientific associations should be represented: that these committees should maintain close touch with active workers, superintend the collection of anthropological data in accordance with the plans and methods formulated by the Central Committee and transmit them to the Imperial Bureau, where they would be collated, printed, and issued from time to time in suitable form.

(13) Too much cannot be said as to the importance from a scientific standpoint of such a scheme. The council thinks it is justified in urging that from the aspect of practical utility such a bureau would render most valuable service for many years to come to all who are engaged in the task of spreading civilisation, whether as servants of the Empire, as traders, or as missionaries and travellers.

(14) The council therefore asks for financial assistance to enable it to provide and equip the bureau with a well-trained and competent staff, and to publish as may be necessary the information collected by local committees with funds at their disposal, to enable them to employ trained investigators when desirable.

(15) The council estimates that for the first five years the cost of maintaining and equipping such a bureau would be

	Staff	Maintenance and Publication	Equipment	Total
	£	£	£	£
1st year ...	300	100	200	600
2nd year ...	300	150	50	500
3rd year ...	400	200	50	650
4th year ...	500	250	50	800
5th year ...	500	250	50	800

(16) The Council recognises the value and importance of the work which has already been accomplished by Government aid in Canada, Australia, India, in Southern Nigeria, Ceylon, and the Anglo-Egyptian Sudan, and desires very earnestly that this work should be carried on with greater continuity over a wider area in accordance with a uniform plan by standard methods of investigation which should be laid down by the Royal Anthropological Institute, the only scientific body which is entitled by its standing to speak with authority on such matters.

A. P. MAUDSLAY, *President*.
J. GRAY, *Hon. Treasurer*.
T. A. JOYCE, *Hon. Secretary*.
(*For the Council of the Royal Anthropological Institute*.)

TECHNICAL EDUCATION AND INDUSTRIES.[1]

THE widefelt need for drastic improvements in our systems of education makes the present period a critical one. We are on the verge of important changes which will probably be made by the Board of Education in its rules and regulations, and this naturally makes the present an anxious time to us as teachers. In addition, we are threatened with what may almost be called a revolt of the ratepayer, who is often far from realising fully the intimate relationship between industrial progress and technical education. Though this subject has been discussed almost *ad nauseam*, I propose to put before you some striking figures derived from the recently published Census of Production, of 1907.

The following tabular statement gives details of net output, number of salaried persons and wage-earners employed, and the net output per head of the nine leading industries already published in the summaries of the census, coal mining being omitted, as this is of a very different character from the other industries. The net output represents the value added to the raw material during the processes of manufacture. For purposes of comparison, I have added the percentages of salaried persons and wage-earners respectively in each industry. A glance at the table at once reveals the important fact that the net output per head broadly rises throughout with an increase of the percentage of salaried persons. Although this conclusion is derived from a comparison of different industries, we are probably safe in assuming that it will hold good in a similar way when applied to different branches of one and the same industry. This suggests that, within certain limits, the employment of a large number of skilled technologists will develop the industry into higher forms, which is accompanied by an increase of productivity. This must in course of time react on the prosperity of the country as a whole, and determine its position in the industrial struggle between the nations of the world.

SUMMARY FROM CENSUS OF PRODUCTION, 1907.

TRADE.	Net Annual Output.	Number of Persons Employed.			Percentage of Persons Employed.		Net Annual Output per head.
		Salaries.	Wages.	Total.	Salaries.	Wages.	
	£						
1. Engineering Factories (including Electric. Eng.)	49,425,000	33,384	416,924	455,561	7·3	92·7	108
2. Cotton Factories	46,941,000	12,391	560,478	572,869	2·2	97·8	82
3. Iron and Steel Factories (including Smelting, Foundry, Rolling)	30,948,000	14,064	248,161	262,225	5·4	94·6	118
4. Woollen and Worsted Factories	19,452,000	9,097	247,920	257,017	3·5	96·5	76
5. Shipbuilding Yards and Marine Engineering Works (Private Firms)	17,678,000	9,452	175,105	184,557	5·1	94·9	96
6. Railways (Construction, Repair, and Maintenance of Permanent Way, Plant and Rolling Stock	17,103,000	8,790	232,736	241,526	3·7	96·3	71
7. Bleaching, Dyeing, Printing, and Finishing Factories	10,369,000	6,154	96,457	102,611	6·0	94·0	101
8. Chemicals, Coal Tar Products, Drugs, and Perfumery Factories	9,464,000	5,981	45,107	51,008	11·7	88·3	185
9. Jute, Linen, and Hemp Factories	9,338,000	3,619	149,845	153,464	2·3	97·7	61
Average	—	—	—	—	4·5	95·5	93

Scientific Research in Industry.

Beaconsfield is credited with having once stated that the chemical trade of a country is a barometer of its prosperity, a statement for which we see there is some justifi-

[1] From the Presidential Address delivered before the Association of Teachers in Technical Institutions at the Southport Conference, June 5, by Mr. Barker North.

cation, considering that it heads the list in net output per head.

There are many problems that are awaiting solution, but these will only be solved by scientific methods applied by the technologist trained in research.

Although in 1907 we were employing, as compared with other English industries, a relatively high percentage of salaried persons in the chemical industries, a large proportion of whom would be technical chemists, it is when we inquire into the type of chemist employed that we find a remarkable difference from the practice adopted in Germany. In England, the work of our chemists is almost entirely of a more or less routine character, whereas the astounding number of research chemists employed forms a distinguishing feature of the German chemical industry. The suggestion recently made that we are incapable in this country of producing technological organic chemists, trained in research methods, is an absurd one; the fact is that the manufacturer, requiring an immediate turnover for his capital, does not, as a general rule, encourage the training of such men by demanding their assistance in the works. His policy, however, is a short-sighted one, as the following contrast of the chemical trades of England and Germany will show the valuable results accruing from the German method.

In 1907 the gross value of the output of the chemical trade in the United Kingdom was $23\frac{1}{2}$ millions sterling, and of this amount a little more than one-third of a million represents the total value of the coal-tar dyestuffs. Germany in 1909 produced aniline colours alone equal to 15 millions sterling in value, approximately two-thirds of the whole of our chemical trade. The imports of coal-tar dyes into England in 1909 increased by 16 per cent., and in 1910 by 10 per cent. The irony of the whole situation is that we celebrated, a few years ago, the jubilee of Perkins's epoch-making discovery of the first aniline dyestuff.

Ten years ago, practically all the indigo put on the market was of natural origin and supplied by British possessions, but certain German firms set out to capture the indigo market by the production of artificial. indigo. In spite of the statement that the natural product possesses certain intrinsic valuable properties not possessed by the artificial variety, and despite the attempts of the English Government to bolster up the Indian indigo trade, in ten years the annual value of indigo imported into this country from India has fallen from a million sterling to less than 50,000*l*. Germany in 1909 exported to Asia alone, the home of the natural indigo, indigotin to the value of 1,900,000*l*. This again is now being followed up by the production of vat dyes, many of them products derived from artificial indigo. These colours being extremely fast, in many cases even to bleaching agents, may yet revolutionise our cotton-dyeing industry. We have not only lost our indigo trade, but in these developments our colour manufacturers are again allowing the German firms to forge ahead.

This forward movement is not confined to the colour trade alone, for the adoption of new processes of manufacture often reacts advantageously on older processes, creating an increasing demand for other products, notably in the heavy chemical trade. At one time Lancashire produced practically all the sulphuric acid of the world; some ten years ago about one million tons were said to be manufactured annually principally in this part of the country, whereas, according to the recent census, the total amount manufactured in the United Kingdom in 1907 was 473,000 tons. This is largely due to the commercial development in Germany and other countries of the "contact process" for the manufacture of sulphuric acid, the initiation of which is principally due to the demands created by the dyestuff industries. It is again interesting to note that the first patent for this process was taken out by Dr. Squires, an English chemist, though the process has been converted into a commercial success in other countries.

This is typical of the advancement and development which has been such a marked feature of the chemical trade of other countries. Examples might be multiplied to prove that in England we are engaged to a large extent in tinkering up the old processes of manufacture, whilst other countries avail themselves of new lines of thought and experiment. The great German industrial concerns, knowing the value of the scientific expert, will often wait for years for the final results of researches which they realise may ultimately revolutionise an industry, or may provide entirely new industries.

Germany has developed a scheme of practical education of the masses which will provide her industries with an army of well-trained workers, and at the same time she has developed to the highest pitch the scientific training of original technologists. It may be that we require more Dreadnoughts, but no number of battleships will prevent our being left far behind in the race of industrial progress if we continue to rest self-satisfied on the laurels of the past.

The more one inquires into the various suggestions that have been made for England's failure to take the lead in industrial developments, the more one is driven to the conclusion that lack of the spirit of organisation and system in both industrial and educational matters is the root of the evil.

In discussing reforms that are necessary in the work of our technical schools and universities, we have to recognise clearly that provision must be made for two distinct types of students, namely, (1) the rank and file of the industrial army; (2) the officers, who will have to organise and direct the work of the rank and file. The ideal principle which should govern the whole system is that the second type should be evolved from the first by means of natural selection. In the earlier years, the training of the two types may therefore be identical, and can be efficiently carried out by part-time instruction in technical schools, as far as possible in the daytime. With regard to higher technical work, this cannot be adequately dealt with in evening classes. We have a unique system of evening classes in this country, doing undoubtedly far better technical work than most people realise, but this system will have to be developed even further if we are to keep pace with the improvements which are bound to follow the increasing application of science to industry.

Higher technological instruction is at the present time given in some six or seven universities, a few university colleges, and many technical colleges and schools.

With respect to our day technical institutions, the following points may be urged in connection with the higher instruction given by them at present:—

(1) The students are too young at entry, and coming mostly direct from secondary schools at the age of fifteen or sixteen, during the first two years they are not old enough to appreciate the necessity for serious study, and have little sense of responsibility.

(2) The student when he has completed his three or four years' training is still without any practical experience such as is gained as an employee in a works. Through lack of this practical experience, he has often an inflated opinion of his own ability and immediate industrial value.

(3) It is only the occasional man who displays the ability requisite for the highest technological positions. Only a comparatively small percentage of those entering the day technical institutions finally display that initiative which is required in the trained technologist. The greater number are only suitable as routine men for second-rate positions, and would receive a more suitable training by entering works and attending evening classes. The explanation for this is that the day students are at present not being chosen by the process of natural selection.

(4) There are too many institutions at the present time all attempting the highest form of technical training in numerous branches, resulting under the existing conditions of selection and supply in small classes and in the unnecessary duplication of expensive equipment for the most advanced work.

(5) The small number of students in each institution does not justify the engagement of the numerous staff of specialists really necessary for the highest form of technological training.

All these defects will be remedied by drafting the most promising of evening students systematically into day courses, and by concentrating them for the highest class of work in specialised institutions, each of which could then afford the necessary elaborate equipment and specialist staff.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

On July 15 the King will lay the foundation stone of the new Welsh National Library at Aberystwyth.

Dr. Shand, of the Royal Scottish Museum, Edinburgh, has been appointed by the council of Victoria College, Stellenbosch, South Africa, to the recently instituted chair of geology.

It is proposed to start in September next, at the Horticultural College, Swanley, Kent, a year's course in natural history for intending teachers of nature study and gardening. The course is designed to give students an insight into field work in natural history based on sound laboratory instruction, and enable them to impart their knowledge to others in simple and intelligible language. The work will be thoroughly practical, and students will be shown how to prepare their own material and construct any necessary apparatus. The course will extend over one session of three terms, thus giving opportunities for field work in all seasons.

Prof. W. A. Herdman, F.R.S., will hold a vacation course on oceanography at the Port Erin Biological Station in September this year, probably in the two weeks following the meeting of the British Association. The exact dates and further particulars will be announced shortly. The practical work of the course will, as last year, be conducted by Dr. W. J. Dakin (as zoologist) and Dr. H. E. Roaf (as physiologist). Prof. Herdman's new steam-yacht *Runa*, which is being fitted up for oceanographical work, will by that time have returned from her contemplated plankton cruise in the Hebrides, and will be available for demonstrations of apparatus and method on board in Port Erin Bay.

The second volume of the 1910 report of the U.S. Commissioner of Education shows that 494 of the institutions of higher learning which report to the Bureau at Washington admit men students, 352 admit men and women, and 108 women only. The report includes much interesting information as to the property and income of the various colleges and universities. We notice that the 494 colleges admitting men students have libraries valued at 3,850,000*l.* The value of their scientific apparatus, machinery, and furniture is given as 6,550,000*l.*; of their grounds, 3,538,000*l.*; and of their buildings, 42,300,000*l.* The productive funds of these institutions amount to 51,875,000*l.* Their income for 1910 reached 16,088,000*l.*, of which 2,320,000 was from productive funds. From the same source much can be learnt concerning the growth of secondary education in the United States. For twenty years the rate of increase in the number of secondary-school pupils has been greater than the rate of increase in population. In 1890 the number of secondary-school pupils was 367,003, or 5900 to the million of population; in 1900 the number was 719,241, or 9500 to the million; and in 1910 it was 1,131,466, or 12,300 to the million. The per cent. of increase in population since 1890 has been nearly 47, while the per cent. of increase in secondary-school pupils has been 208.

SOCIETIES AND ACADEMIES.

London.

Royal Meteorological Society, June 14.—Dr. H. N. Dickson, president, in the chair.—Dr. C. **Chree**: Discussion of the barograph records kept by the late Mr. P. Bell at Castle O'er, Dumfriesshire, during the seven years 1902–8. The records show a well-marked principal maximum and minimum at 10 p.m. and 5 a.m. respectively. Every single year agrees in this except 1908, which puts the maximum at 7 a.m. The existence of a secondary maximum and minimum is unmistakable, but while the hour of occurrence of the former is clearly 11 a.m., that of the latter is less distinct. It seems to be 4 p.m., but a longer series of observations would have been necessary to confirm this.—Spencer C. **Russell**: Experiments carried out at Epsom during the last two years in order to obtain a permanent record of the variations in the size of raindrops as and when they occurred. The first method employed was the exposure of a number of ruled slates divided into ¼-inch sections, and gently brushed over with an even coating of oil. This was not altogether satisfactory, as during heavy rain the drops impinged upon the slate with such force as to become broken up into a series of drops composed of one large and a number of small ones. The most satisfactory results, however, have been given by the use of plaster of Paris. Mr. Russell exhibited to the meeting a number of these raindrop models. He stated that the sizes of the drops which he had already collected were:—7 of 6 mm., 44 of 5 mm., 73 of 4 mm., 222 of 3 mm., 257 of 2 mm., 175 of 1 mm., and 107 of less than 1 mm.—A. J. **Makower**, Dr. W. **Makower**, W. M. **Gregory**, and H. **Robinson**: Experiments carried out at Ditcham Park to investigate the electrical state of the air at different heights above the ground by means of kites and balloons.

Dublin.

Royal Irish Academy, June 12.—Rev. Dr. Mahaffy, president, in the chair.—R. Lloyd **Praeger**: Phanerogamia and Pteridophyta. Part I. Dispersal and distribution. (Clare Island Survey.) In connection with the study of the vegetation of Clare Island, particular attention was paid to the questions of the origin and the age of the flora. The question as to whether the flora could have immigrated across the existing strait which separates it from the mainland was decided in the negative, on the grounds, among others, of its variety and complexity in relation to that of the mainland, the equal abundance of species with or without dispersion devices, and the non-applicability in this case of certain usually potent methods of dispersal. The influence of man upon the flora was also dealt with fully.

New South Wales.

Linnean Society, March 29.—Mr. C. Hedley, president, in the chair.—C. **Hedley**: Presidential address, a study of marginal drainage. Previous to the present cycle, it is believed by geologists that a peneplain extended from New Guinea in the north to Tasmania in the south. Probably this peneplain extended eastwards beyond the limit of the present coast, and was continued seawards by a broad continental shelf. The theory is advanced that the present cycle commenced by the sinking of the ocean-floor, and by pressure upon the border of the continent. In the zone of compression folding ensued, by which the continental shelf was depressed and the coastal range elevated simultaneously. Where the margin of the shelf approaches the coast, so does the divide. From this it is inferred that a broad shelf serves as a buttress to that portion of the continent that lies behind it. Sheltered by this buttress, radial rivers persist as relics from the peneplain epoch. To show that the continental shelf is still being diminished, an instance is furnished by Captain Sharp of how the shelf has retreated from five to ten miles within forty years near Break Sea Spit. A feature of many rivers of our Pacific slope is that, for part of their course, they run in valleys parallel to the shore. Then they are apt to break away and run direct to the sea. Of where and what were the rivers of the preceding cycle, the peneplain times, there is no record. It is obvious that no peneplain could have carried such crooked rivers as the Clarence or the Shoalhaven. Of necessity the peneplain rivers were longer, slower, and straighter than these. How were those peneplain rivers succeeded by an entirely diverse scheme of drainage? The explanation offered is that the crooked rivers lie in a zone of compression; that movements from the pressure-trough threw the coastal area into irregular folds; that these broke and caught the radial rivers, which, turning aside, flowed along their furrows; then at once denudation played on elevation. At every opportunity the river burst through the obstacle which held it back from the shortest way to the sea. Finally, the old channel, chopped in lengths by cross-streams, appears as an empty river-bed. Every stage in this performance is illustrated by the rivers of New South Wales. It is clear that as these great meridional valleys, marginal to the coast, are undergoing rapid dis-

integration by the ordinary agents of denudation, that they cannot have endured such attack for long. Consequently these valleys themselves are geologically recent.—Ordinary meeting, Mr. W. W. Froggatt in the chair.—*Papers read:* D. **McAlpine**: Description of a new smut in a new genus of grass.—T. Harvey **Johnston**: (1) The entozoa of Monotremata and Australian Marsupialia, No. ii.; (2) new species of avian cestodes.

April 26.—Mr. W. W. Froggatt, president, in the chair. —Dr. J. M. **Petrie**: The *rôle* of nitrogen in plant metabolism, parts iii.–v. (iii.) The distribution of nitrogen in the seeds of *Acacia pycnantha*. The seeds contain 4·51 per cent of N in various forms. The changes in the solubility of the protein are examined in various stages of partial neutralisation. A study of the action of various protein precipitants is made. Quantitative precipitation by alcohol of increasing strength brings out a differentiation of the N values, and shows the presence of at least two different proteins. The protein-free solution contains (1) substances which easily set free ammonia when distilled; (2) compounds which liberate ammonia only when hydrolysed with dilute acids; (3) compounds which are only decomposed by boiling with strong acids for prolonged periods; (4) basic compounds. (iv.) The nitrogen of ripening seeds. Experiments on the wild tare, *Vicia sativa*. The seeds, as ripening progresses, gain in protein and also in non-protein N compounds, the mature seeds containing the largest amount of each. The view that the proteins are formed at the expense of non-protein N compounds is not supported. All ripe seeds examined contain non-protein N, which remains unaltered throughout the dormant state. A series of experiments on *V. faba* showed that when the seeds are left enclosed in the isolated pods, a transference of material takes place from the pods to the seeds. This results in an increase in total N and protein N, and a small increase in non-protein N. The seed-protein could only have been augmented by the addition of protein or protein derivatives, and the only possible source is the pods. (v.) The occurrence of potassium nitrate in plants. The occurrence of an unusually large amount of potassium nitrate in the leaves of *Solandra grandiflora*, 2·01 per cent. of the plant dried at 100° C., is recorded.—R. J. **Tillyard**: Studies in the life-histories of Australian Odonata. No. 4. Further notes on the life-history of *Petalura gigantea*, Leach. The account of the life-history of *P. gigantea* is completed. The living nymph, hitherto undiscovered, was found in a swamp at Medlow, Blue Mountains. These larvæ appear to be at least two years in reaching maturity.—E. W. **Ferguson**: The Amycteridæ of the Voyage de l'*Astrolabe*, 1835. The author has had the opportunity of examining Boisduval's types of ten species, from Coll. Dejean, out of a total of nineteen described, the descriptions of the remaining nine being sufficiently full for satisfactory recognition.—W. W. **Froggatt**: Description of a new lac-coccid (genus Tachardia) from New South Wales.

VICTORIA.

Royal Society, April 13.—Mr. Walcott in the chair.— J. **Shephard**: A list of Victorian rotifers, with description of two new species and the males of two species. H. H. Anderson and the author published a Victorian list in 1892. *Brachionus lyratus*, n.sp., and *B. dichotomus*, n.sp., and males of *Lacinularia reticulata* and *L. elliptica* are described.—A. J. **Ewart**: Fruiting of "Blackfellow's Bread" (*Polyporus Mylittae*, Cooke). Sporophores do not form without the stimulus of light.

May 11.—Prof. Skeats in the chair.—W. Baldwin **Spencer** and R. H. **Walcott**: The origin of cuts on bones of Australian extinct marsupials. Bones from localities in Victoria, New South Wales, and South Australia have cuts and marks on them into which the teeth of Thylacoleo will fit, thus confirming its carnivorous habit.—Jean **White**: Bitter-pit in apples. Results of one season's work are given. Several diseases are confounded under the name; the one investigated is caused by spraying with lead arsenate.

CAPE TOWN.

Royal Society of South Africa, May 17.—Mr. S. S. Hough, F.R.S., president, in the chair.—Miss D. F. **Bleek**: Note on the language of Bushman tribes north of the Orange River, illustrated by gramophone records.—L. **Péringuey**: Note on the result of investigations of a Strand Looper Hottentot rock-shelter, with exhibition of the objects found.—R. **Marloth**: Some new South African succulents and other plants, part iv.—J. **Burtt-Davy**: Segregation of two pairs of characters in a cross-bred maize ear.—T. **Muir**: Sylvester's axisymmetric unisignant.

DIARY OF SOCIETIES.

MONDAY, JUNE 26.

VICTORIA INSTITUTE, at 4.30.—The True Temper of Empire: Sir Charles Bruce, G.C.M.G.

TUESDAY, JUNE 27.

ZOOLOGICAL SOCIETY, at 8.30.

WEDNESDAY, JUNE 28.

ROYAL MICROSCOPICAL SOCIETY, at 8.—(1) On the Structure of Scales from *Thermobia domestica*; (2) A Description of a Model producing Optical Effects similar to the Cuneate Markings in Insect Scales: J. Strachan.—Rotifera of New Zealand and S. Africa: J. Murray.

FRIDAY, JUNE 30.

PHYSICAL SOCIETY, at 5.—On the Effect of a Narrow Saw-cut in the Edge of a Conducting Strip on the Stream Lines in the Strip and on the Resistance of the Strip: Prof. C. H. Lees, F.R.S.—The Capacity Coefficients of Spherical Electrodes: Dr. A. Russell.—Exhibition of the Benkö Primary Battery: W. R. Cooper.

MONDAY, JULY 3.

ARISTOTELIAN SOCIETY, at 8.—Emotional Experiences of some Higher Mystics: Rev. A. Caldecott.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Dutch New Guinea: Capt. C. G. Rawling, C.I.E.

CONTENTS.

THURSDAY, JUNE 29, 1911.

DYNAMICAL METEOROLOGY AND HYDROGRAPHY.

Dynamic Meteorology and Hydrography. By Prof. V. Bjerknes and different collaborators. Pp. 146+36A+30B+22C. (Washington, D.C.: Carnegie Institution, 1910.)

IN a lecture delivered at University College in May, 1910, Prof. Bjerknes outlined the methods, described characteristically as rational, by which he hoped to utilise synchronous meteorological observations for a more purely scientific purpose than the preparation of daily forecasts. The present work is the first instalment of a treatise prepared, in collaboration with Dr. J. W. Sandström, with such investigations in view, and is intended to present in an ordered and rational form the principles and development of meteorology and hydrography viewed from the point of view of a mathematical physicist. Bjerknes has realised the fact that economy of thought and labour are essential to advance in meteorological and hydrographic investigation, and although his book bears little actual resemblance to Lagrange's "Mécanique Analytique," we cannot help calling to mind that classical masterpiece of scientific economy in reading this volume.

The existing chaos in meteorological units has led Bjerknes, among others, to the conclusion that a thorough reform in this respect will go far towards making meteorological progress possible through the practical application of more advanced mathematical treatment than is at present customary. He begins therefore by introducing as suitable units for meteorological purposes the metre, the metric ton, or 10^6 grams, and the second, and calls this briefly the m.t.s. system. The metre and the ton are chosen on the ground that the centimetre and the gram are too small as units of length and mass for practical applications, in much the same way as the c.g.s. electrical units are in general unsuitable for the practical engineer. The atmosphere, however, resembles a thin plate, and although the vertical dimensions and motions are relatively small, they are nevertheless important. No combination of units will be appropriate for all cases, and Bjerknes himself departs in some cases from the rational derived units which follow from his scheme. It seems doubtful therefore if it is a wise plan to run the risk of discouraging the reader at the outset by the formal introduction of new units.

The first two chapters are introductory in character, and deal with the units used in the work and with gravity and the corresponding scalar, gravity potential. The unit of gravity potential on the m.t.s. system is called the dynamic decimetre, because it is equal to the work done in lifting unit mass against gravity through a height which is approximately equal to a decimetre. For practical application, however, the dynamic metre is taken, and this unit is fundamental in Bjerknes's work. Its great advantage is that the distance to which it corresponds agrees sufficiently closely with the metre, to make it suitable for expressing approximately *geometric* heights, and points at the same distance in dynamic metres from the earth's surface (sea-level) are on the same level surface of gravity. Bjerknes even makes out a case for publishing the results of geodetic determinations of "height" in dynamic metres, just as in a later chapter he emphasises the need for giving the corresponding values of pressure and temperature in the publication of the results of upper-air observations, instead of height and temperature, the quantities more frequently adopted at present.

Some care is needed to prevent confusion in connection with dynamic decimetres and metres. These are units of work and are invariable, but the heights, with which they correspond, vary with the locality inversely as the value of gravity.

The m.t.s. unit of pressure is the centibar, but here again it is found convenient to take as the practical unit the bar or the megadyne per square centimetre, and the graduation of the barometer in "millibars" is advocated. It seems necessary to proceed cautiously in this connection. It is proper and scientific to express atmospheric pressure in terms of the megadyne per square centimetre or the bar, and it is legitimate to take advantage of any practical device which will enable this to be done as easily as possible; but in using the mercury barometer we are primarily measuring a distance, and equal increments of height do not correspond with equal increments of pressure at different places, or under different conditions at the same place. Meteorologists ought to beware of adding another incongruity to the list of those which they ridicule frequently in a good-humoured way when they have become accustomed to the feeling that long usage has made the bonds too strong to be broken.

Chapter iii. deals with the specific volume and density of air and sea-water. Owing to the fact that the amount of water-vapour present in the atmosphere is a variable quantity, the "constant," R, in the equation $pv=RT$ is variable also, and this constitutes a real difficulty in the discussion of atmospheric changes. Bjerknes reduces the difficulty very considerably by adopting the artifice of keeping R constant throughout, and using in the equation, not the actual temperature T, but the virtual temperature τ, which is the temperature at which dry air would have the same density as the air under consideration. By another ingenious device he makes seven small tables for obtaining the density of sea-water from the temperature, salinity and pressure cover the same range as a quarter of a million pages of straightforward tabulation.

The next two chapters are concerned with the principles of hydrostatics and their application to the atmosphere in the case of constant temperature gradient and for adiabatic equilibrium. They contain an instructive set of diagrams showing for the same scale of height (measured in dynamic metres) the pressure, density, and specific volume of the atmosphere at different levels for the four cases, homogeneous atmosphere, dry atmosphere in adiabatic equilibrium, atmosphere with constant vertical

gradient of temperature $0{\cdot}5°$ C. per 100 m., and isothermal atmosphere. Thus it is interesting to observe that at 20,000 m., for example, the pressures expressed in millibars are in the four cases 0, 10, 42, 79 respectively.

Chapter vi. is devoted to a consideration of the problem of determining the heights at given pressures or the pressures at given heights when the virtual temperatures at given pressures or at given heights are known. The method developed is applied to particular cases in which the observed quantities have been found from the records obtained by means of registering balloons. In calculating the height at which a given isobaric surface is to be found, the distances between consecutive isobaric surfaces are taken directly from the tables, so that the single process gives the entire representation of the field of pressure and mass. The ease and simplicity of the method suggest that meteorologists may find it preferable in their synchronous charts to represent the heights at which a standard isobaric surface is to be found instead of the pressures at a standard level. In chapter vii. such charts are drawn for different isobaric surfaces by using the results of the international ascents of registering balloons. Profile diagrams are also drawn showing the section, by a vertical plane, of the isobaric and isosteric (constant specific volume) surfaces, and of the equipotential and isopycnic (constant density) surfaces. In the equilibrium state no two of these surfaces intersect, and the number of tubes made by their intersections in actual cases is a measure of the departure from the equilibrium condition. This method of viewing the distribution is very suggestive, and deserves further development and application.

Chapters viii. and ix. are hydrographic counterparts of chapters vi. and vii., and complete the formal development presented in this volume, the remaining eighty pages being devoted to the tables necessary for the application of Bjerknes's methods. They will be found of great use in the discussion of the atmosphere as a fluid in three dimensions. They differ in some respects from the tables constructed five years ago by Sandström, and they cover a wider field. There are slight differences in the values for the distance between consecutive isobaric surfaces, which are no doubt due to the revision of Sandström's results.

The impression produced by a study of Bjerknes's book is that it does not contain new discoveries or throw much fresh light on individual atmospheric phenomena, but it presents what is fundamental in our knowledge of the physics of the atmosphere in a new way, and makes possible the application of methods which have hitherto been disregarded, because of the immense labour involved in dealing with even a single case. The temptation to pad the work with examples has been successfully resisted, and the cases discussed are confined to what is strictly necessary in the scheme of development.

The observations in the upper air obtained by means of kites and balloons have hitherto been little used in the synoptic representation of atmospheric conditions, and in the investigation of the dynamical problems which a three-dimensional knowledge was expected to elucidate. They have indeed achieved much in giving us definite knowledge in place of erroneous hypotheses, but ambitious minds naturally wish to turn them to practical use in daily forecasting. Laborious investigation is an essential preliminary to such an application, and Bjerknes, with his large, enthusiastic spirit, has taken up this work in a way which ought to secure him the active support of professional meteorologists. The book is excellently printed, and its form and style produce a sense of pleasure and satisfaction. There is an old rule about leaving the preface of a book until the remainder is completed. Apparently Bjerknes is taking this rule so literally that he is reserving the introduction, as well as the index, until the issue of the final volume.

E. GOLD.

THE JEWS.

The Jews: a Study of Race and Environment. By M. Fishberg. Pp. xix+598. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1911.) Price 6*s*.

IN order to elucidate the problem whether the Jews constitute a race or simply a nation, Mr. Fishberg discusses at considerable length certain physical characters, with the following results. Stature is not homogeneous among the Jews in every country, and its limits of variation are almost as large as are observed in European races generally; further, where the indigenous population is tall the Jews are also tall, and the reverse. It is also evident that the shortness of their stature can be attributed only to a slight extent to the influence of environment or to occupation. Jewish skulls are extremely rare in museums; indeed, there do not appear to be any data whatever for the ancient Hebrews; the cranial index of five skulls of the second century, found in Rome, varies from 75·1 to 83·4; of twelve skulls found in Basel in a cemetery dating from the thirteenth and fourteenth centuries two were dolichocephalic, while the remainder were brachycephalic, the total average being 84·6. The same variability occurs in other finds, but the skulls of most of the Sephardim—or Spanish and Portuguese Jews—are dolichocephalic.

Among the existing population it is found that in countries where the indigenous population is narrow-headed, as in Africa and Arabia, the Jews are dolichocephalic, and where broad-headedness prevails, as in Russia, Poland, and Hungary, the Jews are brachycephalic. The ancient Hebrews must have been either of the one type or the other, or a mixed race originally; the former alternative implies that for most of the Jews miscegenation must have occurred in later times. Although predominantly dark, fair Jews are found everywhere; even among the Sephardim, it appears that the blond type oscillates between 5 and 16 per cent., and between 25 and 50 per cent. are of the mixed types according to the country of birth. The suggestion that the blondness is a product of climatic conditions can be eliminated as worthless, as blond Jews occur everywhere. The combination of tall stature, blond-

ness, and dolichocephaly is not observed among the European Jews, but they have other physical traits of their non-Jewish neighbours.

Prof. F. von Luschan believes that the blond Jews of antiquity may have been the result of intermarriage with the fair "Amorites," but the bulk of the blondness, according to Fishberg, must have been acquired later by intermarriage with non-Jews. He also shows that the predominant type of Jewish nose is straight, nearly 60 per cent., the aquiline being only about 14 per cent. The character of the nostrils, to which Joseph Jacobs directed attention, is characteristic only of the latter type of nose, which von Luschan says should be termed Armenoid and not Jewish or Semitic. It is very commonly asserted that owing to social and religious causes the Jews have retained their "racial purity." Putting aside the dark Jews of India and Abyssinia, among whom proselytising has taken place, we read that in Gaul, Spain, Italy, and Hungary the Jews owned slaves, and records show that the Church has at various times taken measures to prevent them from converting their Christian slaves to their own faith; finally, the Church was compelled to forbid them to own slaves altogether. The descendants of white slaves have been fused with the rest of the Jews, and to-day, after several generations of liberty, they can be no longer recognised; but other causes have contributed to miscegenation. Fishberg supports the statement of Gumplowitcz that "the type or physiognomical character of a folk or social group is not anthropological but social"; he adds, "Mainly for this reason most of the Jews in eastern Europe, who are anthropologically of various types, deceive the casual observer into believing that they all present physiognomical homogeneity."

These conclusions, which he believes to be justified, dissipate the exalted notion of the "Chosen People," who claim that they can trace back their ancestry to their patriarch and progenitor Abraham, as well as the pseudo-scientific theory of the Anti-Semites of a "Jewish race," which is entirely alien in Europe, and incapable of assimilating European standards of morals and fair play. From all the historical evidence available, it appears that the Synagogue and the Church are both powerless to prevent intermarriage between Jews and Christians unless the State comes to their rescue. Such marriages are increasingly taking place; thus there is every indication that the social isolation of the Jew is coming to an end, and that in the near future all the real and alleged differences between Jews and Christians will completely disappear in progressive communities.

The author gives interesting information concerning the marriage-rate, birth-rate, and infant mortality among the Jews, and their pathological characteristics are discussed at length. There are practically no differences between Jews and Christians as regards the incidence of typhoid fever, scarlet fever, measles, diphtheria, &c. The so-called "tenacity of life" of the Jews is mainly dependent upon the great care Jewish mothers take of their children; they nearly always nurse them at the breast, and Jewesses only rarely go to work in factories after marriage. Their lesser liability to consumption is remarkable, perhaps because, being better adapted to city life and overcrowding by a long sojourn in the Ghetto, and by a process of natural selection, there were eliminated most of those who were predisposed to tuberculosis. The only pathological processes which are more frequent among Jews are the derangements of the nervous system.

"The Jew is the most nervous, and, in so far, the most modern of men. He is by the very nature of his diseases the forerunner, as it were, of his contemporaries, preceding them on that perilous path upon which society is urged by the excesses of its intellectual and emotional life, and by the increasing spur of competition."

Many other aspects of Jewish life are dealt with in this interesting and valuable study, such as the social, economic, and political conditions of the Jews. With regard to their future as a people—for we are no longer justified in speaking of a Jewish race—the author evidently subscribes to Ruppin's statement that "orthodoxy and poverty, assimilation and prosperity, are almost synonymous terms with the Jews."

A. C. HADDON.

ALCOHOLIC FERMENTATION.

Alcoholic Fermentation. By Dr. A. Harden, F.R.S. Pp. ix+128. (London: Longmans, Green, and Co., 1911.) Price 4s. net.

THE appearance of Dr. Harden's "Alcoholic Fermentation" will be warmly welcomed by those engaged in studying problems connected with yeast and the production of alcohol. Dr. Harden's own contributions to the question of alcoholic fermentation are so well known that one expects and finds in this small volume a good up-to-date general survey of the subject. The material is divided up into eight chapters, of which the first is devoted to historical introduction, whilst the next four deal with the properties of zymase and the theories which have been developed since Buchner's fundamental discovery of the dependence of fermentation on enzymes rather than on necessarily living organisms.

In dealing with the accelerating effects of phosphates, arsenates, and arsenites on the course of fermentation, Dr. Harden compares the ideas of von Lebedew and Iwanoff with his own conception of the constitution and function of the "hexosephosphate," which he formulates as the salt of a hexose-diphosphoric acid, whilst Iwanoff regards the substance as a triose-phosphoric acid, $C_3H_5O_2(PO_4H_2)$. Perhaps the strongest evidence in favour of the hexose-diphosphoric acid formula is afforded by the observation of Harden and Young, that when hydrolysed, fructose, as well as phosphoric acid is produced. The significance of the phosphate derivatives is such that one must welcome the synthetic production of phosphoric ester-acids of sugars and allied compounds now being effected by Contardi and Neuberg.

Some interest attaches to Neuberg and Pollak's synthesis of salts of monophosphoric acids of sucrose and glucose, as they have been isolated in analysable condition, and, though not of glucoside type, need to be hydrolysed before undergoing fermentation with yeast. In the case of the hexose-phosphate of alco-

holic fermentation, probably the aldehyde-group participates in the formation of the ester-acid. Dr. Harden remarks (p. 46),

> "the identity of the products from glucose, mannose, and fructose may be explained by regarding the acid as a derivative of the enolic form common to these three sugars, or *by supposing that portions of two sugar molecules may be concerned in its production.*"

The "equation of alcoholic fermentation,"

$$2C_6H_{12}O_6 + 2PO_4HR_2 = 2CO_2 + 2C_2H_6O + 2H_2O + C_6H_{10}O_4(PO_4R_2)_2,$$

whilst recording the experimental facts, scarcely affords an explanation of the formation of alcohol, as it is not obvious why, when one of two glucose molecules forms hexose-phosphate, the other should yield carbon dioxide and ethyl alcohol. Perhaps the part of the above quotation which the reviewer has put in italics furnishes a clue.

Chapter iv., dealing with Harden and Young's discovery of the coenzyme of yeast-juice and its remarkable properties, is of considerable interest, and the possibility of this containing the phosphate group referred to, though it is admitted that experiments have so far yielded only negative results. The next chapter is devoted to the action of inhibiting and accelerating agents on the enzymes of yeast-juice, whilst in chapter vi. the by-products of alcoholic fermentation are dealt with. The results of F. Ehrlich's brilliant work on the production of higher alcohols are clearly expounded, and production of aldehydes and glycerol referred to. It is a matter of interest that only living yeast appears to be capable of producing alcohols from the amino-acids, and even then only does so in presence of fermentable sugar. The discovery of zymase has furthered the solution of the fermentation problem, but the stability of the amino-acids in the absence of the living organism, and the superiority of yeast itself over preparations of its enzymes in effecting the conversion of hexoses into alcohol and carbon dioxide need further explanation.

The chemical changes involved in fermentation are dealt with in chapter vii., and the various explanations put forward at different times are recorded; the reader cannot fail to be struck with the small measure of success which has so far attended these efforts.

Chapter viii., on the "Mechanism of Fermentation," is rather condensed in comparison with the rest of the work; here, however, one departs somewhat from the biochemical aspect of the problem which has been treated by Dr. Harden in so successful a manner. J. T. H.

A CRITIC IN GEOLOGY.

L'Évolution des Théories géologiques. By Prof. S. Meunier. Pp. 366. (Paris: F. Alcan, 1911.) Price 3.50 francs.

THIS is one of the most useful works that Prof. Stanislas Meunier has given to his geological colleagues, and at the same time it will be appreciated by the general reader. The latter, however, must be constantly on his guard, lest he cry out, "A hit, a very palpable hit," every time that Prof. Meunier tilts against the theories of to-day. In an introduction intended to show the inexactitude of the works of nature when compared with the demands of mathematics, the author seems to include in the same order of things the forms of basalt columns and those of crystallised minerals; he rightly points out the irregularity of the former, but says of man (p. 12),

> "à la place des formes toujours variées des objets naturels, il a inventé les formes géométriques . . . tetraèdre, cube, rhomboèdre . . . auxquels il rapporte les objets véritables."

Prof. Meunier doubts the conclusions of the chemist when he remarks, "De même, à la place des composés naturels, il à inventé des composés définis; oxydes, acides, sels," &c. All this is harmless Meunierism to the trained geologist, and will be taken in good part, like the author's rejection of the reality of the Ice age; and it is undoubtedly good for us to have the erroneous conclusions arrived at in the past by the "unanimity of geologists" pointed out as a warning for our later age.

The history of geological thought exhibits to us a science more cumbered by theory in its earlier stages than it is at the present day, and Prof. Meunier does well to begin with cosmogony, tracing the study from Moses to Sir George Darwin. The form of the earth and the nature of its interior are then discussed, with references in the main to French authors. But in succeeding chapters the literature of the world is freely drawn on, and is often criticised as freely. The chapter on mountain building is of special interest, though a more regular chronological arrangement would have aided the reader. The author hails with complete approval the views of Suess on horsts, and of Schardt and Termier on horizontal overfolds, and justice is done (p. 99) to Reyer's theory of gravitational sliding.

The chapter on earthquakes is still more injured by lack of systematic arrangement, and cannot be regarded as complete. In that on metamorphic theories we should have liked to find the names of Scrope and Darwin, both of whom had such clear views on foliated rocks; but Hutton, Lossen, Lehmann, and Michel Lévy are similarly passed over, and the chapter is a brief essay rather than a history. Rivers and glaciers are more adequately dealt with. The chapter on the latter concludes (p. 282) with the following amazing statement as to the striated pebbles found in boulder clays:—

> "Or il est maintenant démontré que les stries . . . ne sont aucunement d'origine glaciaire et qu'elles dérivent entièrement du phénomène d'érosion réalisé dans la masse des éboulis par l'infiltration des eaux de pluie."

Has Prof. Meunier ever consulted an agriculturist as to the penetration of boulder-clay by rain, or has he seen the scratched blocks in a modern glacial deposit, newly revealed from Arctic ice? He continues the discussion when dealing with "théories sédimentaires," and asserts firmly (p. 301) that "pratiquement les glaciers ne strient pas de galets." French tourist steamers now penetrate the fjords of Spitsbergen, and Prof. Meunier should certainly ask one of these to land

him on the arid shores, strewn with striated boulders, of Tempel Bay or Cora Island.

The transport of boulders and striation of rock-floors by ice are, of course, fully admitted, and we have interesting references to Playfair, Perraudin, and de Charpentier. A short account of the origins of sedimentary rocks follows, in which, by a slip, fresh-water shell-limestones become included under "roches argileuses." This part of the book may be regarded as consisting of somewhat scattered notes, all of which have an interest for the professed geologist, but which do not systematically express the growth of geological opinion.

The absence of an index is astonishing. Perhaps the publisher quailed before the proper names, which are very imperfectly corrected in the text. We have Leibniz, Hitchkock and Hitchcok, Mayer-Aymar, Uscher, Revenier, Spalanzani, Moris Davis, d'Aubuisson de Voisin, and Deshays. One or two dates seem erroneous by about a century.

G. A. J. C.

LEAD SMELTING.

The Metallurgy of Lead. By H. F. Collins. Edited by Sir W. C. Roberts-Austin, K.C.B., F.R.S. Second edition, thoroughly revised and enlarged. Pp. xx+538. (London: C. Griffin and Co., Ltd., 1910.) Price 21*s.* net.

We welcome a revised and enlarged edition of this useful work, as the progress of metallurgy is now so rapid and great improvements have been made in smelting during the last decade. A too brief reference has been made to the physical properties of lead and that of its alloys, and much recent work has been overlooked, probably due to the aim of the author in making the work chiefly a compendium of information on lead smelting, which is here brought well up to date. Ore roasting has received the attention it deserves, and we are glad to find that pot roasting is clearly described, and the chemical reactions occurring in this novel process fully discussed, since a correct knowledge of the chemical changes that occur in any process often leads to advancement and discoveries. Useful data are given as to costs in the various modifications developed from the Huntingdon-Heberlein process.

The most suitable fuel for a given ore is here rightly considered, as well as the proper amount to be used in each case. But the twyer ratio and twyer efficiency are also of great significance, and it is a pity more attention has not been given to the pressure and volume of air supplied to each furnace.

The principles of blast-furnace lead smelting are clearly expressed, as the method of dealing with each constituent, according to its quantity, is essential for economic working. It is also equally important that the proper flux should be applied in order to produce the most suitable slag and to obtain the maximum quantity of metal. This is dealt with in a plain and lucid manner. A comprehensive description of modern furnaces with plentiful illustrations is a good feature in this edition, the parts being described in considerable detail. The important subject of water-jackets receives due attention as more refractory ores have now to be dealt with, necessitating greater height of jacket than formerly. It is shown that with increase of size of furnaces and amount of output larger fore-hearths are required and greater facilities for separating matter and slag. The treatment and disposal of slag are also given due prominence. Formerly the production of matte was considered a necessary evil, but it is now esteemed a desirable thing, since the lead is better reduced and the slag more free from lead and silver.

The various products of lead smelting are amply described, as well as the methods adopted for dealing with them at different works.

In chapter xi. examples of lead smelting in the chief European and American works form the subject of narration, and the following chapter deals with costs and losses.

As all lead ores carry silver and sometimes gold, it often becomes more profitable to work for their extraction than that of the lead itself. The author devotes about 100 pages to a consideration of this important subject. A valuable part of this section is the description of the methods of separating gold from zinc crusts.

In chapter xix. works assaying and analytical methods are dealt with.

In the following chapter the difficult subject of treatment of zinc-lead sulphides is considered, and various methods of separation discussed.

The last chapter deals with flotation processes, which have in recent years assumed great importance.

We consider this work a valuable contribution to the metallurgy of lead, in which so much new matter has been introduced, and it can be confidently recommended as a trustworthy guide to anyone who is interested in the subject.

THE TRISECTION OF AN ANGLE.

The Trisection of the Angle by Plane Geometry: Verified by Trigonometry with Concrete Examples. By Dr. J. Whiteford. Pp. 169. (Greenock: J. McKelire and Sons, Ltd.; Edinburgh and Glasgow: J. Menzies and Co., Ltd.; Cambridge: Bowes and Bowes, 1911.)

The *Paralogistes pseudomathematicus* has become so rare, or possibly so shy, that it is a real pleasure to find that the species is not extinct. Alack! that De Morgan is not with us, to do justice to this latest attempt at solving one of the three famous problems that have been proved to be beyond the power of Euclidean constructions. The curious thing is that the author, in his introduction, gives two long quotations from De Morgan, in which he states the conditions of the problem with the utmost precision, except that he does not explicitly say that the trisection must be performed by a finite number of operations. It is here that Dr. Whiteford has come to grief, for his method is nothing more or less than successive approximations, each of which involves a Euclidean construction. It is only fair to add that the author is no vulgar paradoxer, and that his method, as an approximation, is sound, and leads to accurate values with a comparatively small number of

trials; thus in his examples he works to seven places of decimals, and we have not noticed a case in which more than seven trials are required. The one, unfortunately fatal, objection, is that he has ignored the conditions of the problem; it is as though the value of π were found from the perimeter of a regular polygon of 2^n sides. By taking n large enough, we can get by Euclidean construction a value as near π as we please; but it is needless to say that this is not what is meant by "squaring the circle" with rule and compass.

Dr. Whiteford's method is sufficiently ingenious to deserve a brief description. Let AP be an arc of a circle, of which AOB, COD are perpendicular diameters; then if through P a line PQRS be drawn cutting the circle in R, and the diameters CD, AB in Q, S, so that QS=AB, then the angle ROB is one-third of the angle AOP. This theorem was known to the Greeks, and, in fact, led to the invention of the conchoid of Nicomedes as an auxiliary curve for the trisection of the angle. If we take Q anywhere on CD and produce PQ to S, making QS=AB, the locus of S is a conchoid, and its intersection with AB gives the solution of the problem. Now Dr. Whiteford gives a construction for a point on AB, which is in no case very far from S, and thence obtains a sequence of points which have S for their limiting point. After translating his construction into trigonometry, he gives fifty-one worked-out examples, so variously distributed over the quadrant as to leave no doubt that his sequence does actually converge in every case, though, as might be expected, he makes no attempt to prove this fact.

It is easy to draw the obvious moral that it is waste of time to attack a mathematical problem without completely understanding what the problem is. However, this is perhaps ungracious; let us rather conclude by admitting that Dr. Whiteford has added one more to the fairly numerous approximate solutions of this celebrated problem. G. B. M.

LILIENTHAL'S WORK ON AVIATION.

Birdflight as the Basis of Aviation: a Contribution towards a System of Aviation, Compiled from the Results of Numerous Experiments made by O. and G. Lilienthal. By Otto Lilienthal. With a biographical introduction and addendum by Gustav Lilienthal. Translated from the second edition by A. W. Isenthal. Pp. xxiv+142+viii plates. (London: Longmans, Green, and Co., 1911.) Price 9*s*. net.

THE interest of this book lies chiefly in the biographical part. The two Lilienthals, born in the town of Anklam, were from childhood devoted to mechanics, and also to natural history. Otto gained practical knowledge as a mechanic in the works of Schuarlzkopf in Berlin, while his brother was educated as an architect. Watching the flight of the storks which abounded about their home seems to have given them their first taste for the problems which afterwards occupied so much of their attention.

One curious passage (p. 103) is here quoted. After a picturesque description of the storks following the harvesters to pick up field mice and such "small deer," and a reference to the high regard in which the birds are held by the farmers, we read:—

"Thus it is not to be wondered at if the farmers, above whose homesteads these birds with a span of two metres hold great flight meetings every year, evince great interest in the art of flight, though they do not wish it to be known, fearing ridicule. Nevertheless, from no other trade or profession have so many inquiries for light engines—for a secret purpose—reached the author, as from farmers."

The theoretical part of the book is not of any great value, and some of the diagrams (notably those on pp. 45 and 56, of the flow of a stream past an obstacle) are very far from representing the actual facts.

Lilienthal seems to have attached great importance to curved, as against plane, and flapping, as against fixed wings. Flapping wings are really the more efficient of the two, but not for the reasons given.

Difficulties of mechanical construction have hitherto prevented their adequate trial on a large scale, but it would be too much to say that they are impracticable.

The merit of the curved wing section now generally in use is not that it gives an increased lift or efficiency, but that the efficiency does not vary so rapidly with the change of inclination to the air current as happens when the surfaces are planes.

It is seldom that the enthusiasm, mechanical ability, knowledge, and money necessary for experiments in a new field are found in the possession of one and the same individual. Lilienthal had the two first, but was hampered as regards the others. This book, however, which is well translated, should be read as giving a very interesting account of the work of a typical "inventor" of the best class.

A. MALLOCK.

OUR BOOK SHELF.

A Systematic Handbook of Volumetric Analysis; or, the Quantitative Determination of Chemical Substances by Measure, Applied to Liquids, Solids, and Gases. By F. Sutton. Tenth edition. Revised throughout, with numerous additions, by W. L. Sutton and A. E. Johnson. Pp. xiv+621. (London: J. and A. Churchill, 1911.) Price 21*s*. net.

A BOOK that has been the standard text-book on its subject for nearly fifty years, and continues to enjoy that position, calls for little remark as edition after edition is issued. Every student of chemistry knows, or ought to know, his "Sutton," as he knows his "Fresenius," and it would therefore be superfluous to attempt to describe its character and scope. The author, being now eighty years old, has placed the preparation of this tenth edition entirely in the hands of the two editors named in the title. There seems to be every evidence that the editors have done their work thoroughly and judiciously. They say that a good deal of obsolete matter has been deleted, and we naturally turned to some of those classical methods that have served so well in the past, such as Bunsen's method of gas analysis, and have been almost wholly replaced, rather than superseded, by processes that are more suitable for technical work. But the

old method of making and graduating, as well as calibrating, gas burettes is retained, though the apparatus for graduating and etching them would probably be regarded as curiosities in a modern laboratory.

By means of a new setting, and a rather smaller though quite clear type for some paragraphs and sections, space has been economised, and the volume, with all its added matter, is practically of the same size as the last edition. The deletions have in no sense altered the character of the book as giving full practical instructions, but in some cases, where a suggested modification is of comparatively little importance, or an application of a process is of very restricted use, the editors give only a short statement and refer to the original description by the author. In many cases they have taken advantage of the assistance of experts who have had exceptional experience of various methods. All factors and numerical details have been recalculated according to the latest "International Atomic Weights." The section on weights and measures has been rewritten, using the data adopted at the National Physical Laboratory.

In short, the editors appear to have spared no trouble to maintain if they could not enhance the reputation of the book, and thus to merit the gratitude that the aged author expresses in his preface, and, we may add, the thanks of all those who are interested in the subject with which it deals.

The Influence of Strong, Prevalent, Rain-bearing Winds on the Prevalence of Phthisis. By Dr. W. Gordon. Pp. xiv+108. (London: H. K. Lewis, 1910.) Price 7*s*. 6*d*. net.

FOR many years Dr. Gordon, in a series of papers, has brought before the medical profession evidence that strong rain-bearing winds have a very definite influence on the prevalence of phthisis. He has now collected these papers, and, in a work bearing the above title, gives a complete account of his observations. He maintains, as a result of these observations, that in any situation exposed to rain-bearing winds, whether it be over a wide region or merely the side of a street, the mortality from pulmonary phthisis is high. He works this out specially for Devonshire, but takes Exeter streets at one extreme and the civilised world at the other, always coming to the same conclusion. In all this, however, he does not, by any means, ignore other factors, especially "soil" and poverty. Our author points out that this high mortality from consumption is not due merely to a depression of vitality, for it is found that the general death-rate is not affected in the same way as is the phthisical death-rate. Moreover, he is satisfied that the action of the rain-bearing wind is exerted directly on the person exposed to it and not indirectly, "either through closure of doors and windows against the wind or by it driving wet into the walls of the houses."

It is, of course, difficult to test the accuracy of Dr. Gordon's observations, but his figures certainly seem to prove that, taking female death-rates as offering a safer basis of inquiry, in the rural districts of Devonshire, swept by rain-laden winds, the mortality is higher than in those where the winds are dry. Dr. Gordon, not shirking the numerous criticisms that have been directed against his conclusions, has certainly made out a very strong case for the accuracy of his hypothesis. As dealing with one of the side-issues of the tuberculosis question, as opening up a new field of inquiry, and as affording a guide to those in search of places to which consumptives may be sent, although it is not designed for that special purpose, this work will be of very considerable value. The coloured charts on which the statistics are both based and recorded are exquisitely drawn and reproduced. We congratulate Dr. Gordon on the completeness of his work.

Die Naturwissenschaften in ihrer Entwicklung und in ihrem Zusammenhange. By Friedrich Dannemann. Erster Band, Von den Aufängen bis zum Wiederaufleben der Wissenschaften. Pp. viii+374. Leipzig: Wilhelm Engelmann, 1910.) Price 9 marks.

THIS is the first of four volumes designed to give a connected history of the development of all the sciences, with especial regard to their connection with each other. It deals with the earliest records of geometrical and arithmetical learning among the Egyptians and the Sumerian conquerors of Mesopotamia; proceeds to the Greeks from Thales to Aristotle; sketches the development of science in the Greek colonies, the two periods of Alexandrian learning, the Arabian era, and the decline of the Middle Ages; and finally describes the revival of learning in the fifteenth century.

In dealing with Babylon, the author makes some telling extracts from the Nippur tablets, which date back to between 2200 and 1350 B.C., to show that a decimal system of notation is used in the cuneiform inscriptions, without, however, the use of the zero circle, which was introduced by the Indians, and brought to Europe by the Arabs.

In a work like this one misses a description of the Egyptian orientations of temples and pyramids with regard to particular stars. The recent Cretan discoveries are not included, and Chinese observations are only briefly touched upon. But the book is written in a very entertaining style, and as it is plentifully supplied with references, it forms a useful guide-book through the historic development of the sciences.

A Course of Plane Geometry for Advanced Students. Part II. By C. V. Durell. Pp. xiv+358. (London: Macmillan and Co., Ltd., 1910.) Price 7*s*. 6*d*. net.

THE first part of this work, on the straight line and circle, has already been reviewed. The present volume, which treats of conics, shows the same merits of clearness, conciseness, and good judgment. For example, there is a fairly complete account of involution, which is by far the most powerful instrument for developing the properties of conics; and, in order to avoid, on one hand, a lack of rigour, and on the other a difficult theory, the author has frankly based his treatment on an algebraic foundation. Other chapters deal with homography in general, reciprocation and projection; there is even a brief outline of practical solid geometry, though this is too sketchy to be of much use. There are various historical notes, excellent diagrams, and a vast collection of exercises; altogether Mr. Durell's book may be recommended as a trustworthy, practical, and interesting text-book.

M.

The Phase Rule and its Applications. By Dr. Alex. Findlay. Third edition. Pp. xvi+356. (London: Longmans, Green, and Co., 1911.) Price 6*s*.

THE first edition of Dr. Findlay's book was reviewed in these columns on April 21, 1904 (vol lxix., p. 579), and the arrangement and general character of the work remain much the same as they were. In the second edition numerous additions were made to bring the information up to date, and though no changes of a fundamental nature have been made in the present edition, paragraphs have been added where necessary on the results of recent researches. In addition to this, the whole book has been subjected to careful revision.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

New Use for Eucalyptus.

THE following extract from a private letter deserves a wider publicity :—

W. T. THISELTON-DYER.

You may perhaps remember the work published in 1902 from this institution on "Eucalypts and their Essential Oils." Prior to this the eucalyptus oil industry was in a chaotic state in Australia, the New South Wales article being almost unmarketable. By working out the species on a basis as laid down in the work (*supra*)—that is, a natural one—many new products were discovered, such as geraniol, the active principle in the otto of roses; a dextro- and a lævo-turpentine corresponding to the American and French respectively; many eucalyptol oils (medicinal), in addition to those previously known; citral, from which ionone, the artificial perfume of violets, is made; citronellal, corresponding with the product obtained from the lemon grass of India; eudesmin and other products of unknown economic value at present.

The British pharmacopœia laid it down that no eucalyptus oil should be sold unless it contained not less than 50 per cent. eucalyptol, but such did not hold good for Australia; consequently *any* oils were sold for therapeutic purposes.

But recently, through our instrumentality, the Health Board has passed a regulation that the B.P. standard should obtain here; consequently there has been a "slump" in the oils thus disqualified, and so these became worthless. Naturally the distillers were very much put out with us, and some travelled so far as Victoria and Queensland to interview us and discuss the matter. But the hands of the clock could not be put back.

The now discarded oils have been classified by the chemist as phellandrene oils, and the particular gum trees yield them in larger quantity than any other oils, and the desideratum was to find an industrial avenue for their utilisation. Well, this is how it has come about. There are at certain large mining centres here millions of tons of "tailings," containing particles of minerals very finely divided, and the trouble in the past has been to extract these profitably, and many methods and patents have been adopted, but none satisfactorily.

At Broken Hill, our greatest mining centre, chemical investigation has been carried on for some time, and a complete series of essential oils of our own extraction and true to botanical names was forwarded for trial. The result was that the phellandrene oils yielded from 86 to 90 per cent. concentrates, the highest of any oil experimented with! Here indeed was a market. The demand for these particular oils has at once enormously increased; hundreds of tons are required, for the method will be introduced into U.S.A., Canada, Queensland, and through all Australia, South Africa, and wherever the industry obtains.

Its utilisation is the essence of cheapness, and the information on a sample that I brought from Broken Hill myself reads as follows:—Zinc concentrates; about Zn 47 per cent., Pb 10 per cent., Ag 15 oz.; recovered by eucalyptus oil ½ lb. per ton of concentrates.

When we started out on our research on eucalypts we little thought that the oil would play so important a part in mining. RICH. T. BAKER.

Technological Museum, Sydney, April 7.

The Date of the Discovery of the Capillaries.

THE discovery of the capillary blood-vessels being an event of such supreme importance in biology, it is highly desirable that the date of it should be accurately ascertained. It so happens that it is known for certain it was made in the year 1660 by Marcello Malpighi in the city of Bologna, and yet nearly every author gives the date of this discovery as 1661.

The latest statement of 1661 is in Prof. Miall's delightful little book "The History of Biology," in which in the useful chronological table we find :—

"1661. Passage of blood through capillaries observed by Malpighi." As justifying this date, he would doubtless point to the note at the head of the table:—("The date of a discovery is the date of its first publication when that is known.")

Now while in many cases this principle may be not only a convenient one, but the only one capable of application, yet in certain cases it is a principle not to be followed at all.

These cases are those in which we have evidence regarding both the date of a discovery and the date of its being made known.

For instance, the date of the *discovery* of the circulation of the blood by William Harvey is certainly earlier than 1628, the date of its publication.

We have the evidence of Harvey's own lecture notes, dated 1616, that he knew of the circulation and was teaching it at least twelve years before he published it. Only when we cannot find the true date of a discovery should we fall back on the date of its publication.

Now the discovery of the existence of the invisible capillaries was a very great thing, and it seems a pity that we should get into the habit of assigning it to one year later than it actually was made.

Sir Michael Foster's account in his "Lectures on the History of Physiology" is clearness itself. Speaking of Malpighi, we read:—"Here" (Bologna) "he resumed office as a Professor of Medicine, and in spite of domestic troubles and anxieties, pursued his researches to such good effect that he was able in the next year, 1660, to announce privately to Borelli his discovery of the structure of the lung, an account of which was published in the year following."

The published account alluded to is his "De pulmonibus observationes anatomicæ," which, after the manner of the time, is in the form of two letters to his friend G. A. Borelli, at Pisa.

In the second epistle he describes the circulation in the herniated lung of the living frog. He heads the description with these words, "Magnum certum opus oculis video"—"I see with my eyes a great, certain thing," not, as always translated, "a certain great thing," which is much feebler and not a true translation.

1660, then, and *not* 1661, was the date of the discovery of the blood-capillaries, within only three years of the death of Harvey in 1657. Harvey made their existence a logical necessity; Malpighi made it a histological certainty. As we still speak of the "rete mirabile Malpighii"—for no lapse of time can ever make that rete less wonderful—we might as well take the trouble to assign the discovery of it to its correct date, 1660. D. FRASER HARRIS.

The University, Birmingham, June 19.

The Osmotic Pressure of Colloidal Salts.

CONGO red and similar salts in aqueous solution cannot diffuse through an ordinary dialysing membrane. When the osmotic pressure is directly measured by an osmometer it is found to be about that which the kinetic theory would ascribe to the salt present if the molecules were completely un-ionised.

The solutions, on the other hand, are good conductors of electricity, and the specific molecular conductivity of the solutions employed is that of a solute 60 to 70 per cent. of the molecules of which are dissociated. There is thus, as Bayliss has pointed out,[1] an apparent conflict between the results obtained by different experimental methods.

Congo red is the sodium salt of a complex organic acid. Its ions, therefore, are of very unequal size, and as the membranes employed in the osmometer are permeable to

[1] Paper read at the meeting of the Biochemical Society, May 4.

ordinary salts, they may be assumed to be permeable to the sodium ion, while holding back the much larger organic ion. On the other hand, it is found in actual experiments that the sodium ion does not escape from the osmometer.

Many collateral results show that the membrane does not *mechanically* directly constrain the sodium ion from diffusing. Thus a membrane, even when deeply impregnated with congo red, will permit the passage of sodium sulphate. Biltz and von Vegesack,[1] in order to explain the results, assume that the sodium ion of congo red, because it can diffuse through the membrane (and in spite of the fact that it actually does not do so), therefore contributes nothing to the osmotic pressure. I find myself quite unable to accept this view.

Osmotic pressure is a measure of the total constraint imposed on the system solution and pure solvent by a membrane. To the organic ions, owing probably to their size, the membrane offers what may be called a mechanical constraint. The sodium ions, on which the membrane exerts no such direct mechanical constraint, do not escape, because they are held back by the electrostatic attraction of the negatively charged organic ions. When equilibrium is reached, the electrostatic pull inwards must balance the osmotic pressure, which tends to drive the sodium ions outwards. The total pressure borne by the membrane, therefore, is the sum of the osmotic pressure of undissociated molecules, of the organic ions, and of the sodium ions held back by their attraction to the organic ions.

On this view, the osmotic forces would produce at the membrane an average orientation of plus and minus ions, which should appear as a contact potential difference between the solution and the solvent. The magnitude of the electromotive force can be calculated in several ways, of which the simplest is as follows.

If E be the potential difference of the quasi-condenser formed by the ions, P the osmotic pressure, and c the concentration of the dissociated salt in gr. equivalents per c.cm., then the osmotic force acting outwards on one gr. equivalent of ions is $\frac{1}{c}\frac{dP}{dx}$, and the electrostatic pull inwards is $\frac{dE}{dx}q$, where q is the charge on one gr. equivalent. Since these balance one another, we have

$$\frac{dE}{dx}=\frac{1}{cq}\frac{dP}{dx},$$

putting $c=P/RT$ we have

$$\frac{dE}{dx}=\frac{RT}{qP}\frac{dP}{dx},$$

which on integration gives

$$E=\frac{RT}{q}\log\frac{P_2}{P_1}.$$

This expression differs from Nernst's well-known equation only in the absence of the terms representing the rate of diffusion of the ions.

From what is known of colloidal solutions, it is possible that, except at a high dilution, some of the positive electricity might be carried by complexes too large to penetrate the membrane. These would contribute either nothing at all, or something less than the amount given by an equal number of sodium ions, to the potential difference. Their presence, therefore, would cause the calculated values to exceed the observed values.

W. B. HARDY.

[1] *Zeits. f. physik. Ch.*, 73, 481, 1910.

The Fox and the Fleas.

In reference to the letters of Prof. Hughes in NATURE of March 23 and April 13, and his query as to whether the device adopted by foxes for divesting themselves of fleas is "instinctive," may I be permitted to give some particulars of a similar practice which has been observed in this country?

Foxes were introduced into Victoria from England in the early days of the colony, and are now plentiful even in the neighbourhood of Melbourne. Mr. P. R. H. St. John, of the Botanic Gardens, tells me that, whilst botanising or shooting in the neighbourhood of Point Cook during the 'eighties, he has on at least a score of occasions seen foxes enter the water with apparently the same object as the fox observed by Mr. Day.

Point Cook is situated on the west shore of Port Phillip Bay, and is about twenty miles from Melbourne. The surrounding country, being marshy, covered with saltbush, and of little agricultural value, was practically uninhabited, and a favourite hunting-ground for naturalists.

The procedure adopted by the fox was to retreat slowly into the shallow water (the beach being very level at that spot) until only the head was visible, and then it would disappear completely and rise to the surface about a yard away, and, leaving the water with a bound, the fox would rapidly reach the shore, shake itself like a dog, and make off into the bush. The time occupied by the whole operation, which was only attempted when the water was quite calm, would be about three or four minutes.

Mr. St. John, though never closer than about fifty yards, did not think that the foxes he observed held any wool or fur in their mouth (there were no sheep grazing in the locality), but he and his father, and various friends who accompanied him, had come to the conclusion that the object must have been to rid themselves of the fleas which were always to be found on those specimens which they shot.

It will be noticed that this manœuvre differs materially from that of the English foxes in that no wool or fur was used. This would suggest less call on the reasoning power of the fox, but on the other hand the deficiency was made up for by a final complete submersion and (there being no current) a side movement and a rapid escape from the water to dodge the dislodged and probably floating fleas.

The proverbial cunning of the race is surely to be seen in this adaptation of method to the conditions to be found on an uninhabited coast.

HEBER GREEN.

Agricultural Chemistry Laboratory, The University of Melbourne, May 23.

Chemistry at the Forthcoming Meeting of the British Association.

MAY I direct attention to the following features in the provisional programme of Section B (Chemistry) at the British Association meeting in Portsmouth, beginning on August 30 under the presidency of Sir William Ramsay?

(*a*) Joint discussion with the section of agriculture on the part played by enzymes in the economy of plants and animals.

(*b*) Discussion on colloids (opened by Prof. Freundlich, Leipzig, with a contribution on the theory of colloids).

(*c*) Discussion on indicators and colour.

Many foreign chemists intend to be present—amongst others, Profs. Ostwald and Freundlich (Germany), Wegscheider (Austria), Gautier, Haller (France), Clarke, Barus (America), Righi (Italy), Pettersen, Euler (Sweden), Birkeland (Norway), Zeeman, Cohen (Holland)—and it is to be hoped that there will be a numerous attendance of British chemists to do honour to these and other distinguished guests.

JAMES WALKER.
(*President, Section B.*)

Edinburgh, June 24.

Breath Figures.

LORD RAYLEIGH'S communication on breath figures (NATURE, May 25, p. 416) puts me in mind of an experiment—if I may call it so—we made when we were children. After breathing on a window-pane we wrote our names on the glass with the point of a finger. Now after having waited until the moist deposit had disappeared, and again breathing on the glass, the written characters became quite legible.

This seems quite to agree with Lord Rayleigh's explanation, grease on the fingers causing the phenomenon.

Delft, June 6.

J. W. GILTAY.

THE SCOTTISH SURVEY MEMOIRS.[1]

THESE three memoirs mark an important change in the publications of the Scottish Geological Survey. The maps are now colour printed instead of being hand-coloured. This is an improvement for which all Scotch geologists will be profoundly grateful. The cost of the hand-coloured maps at their present outrageous prices is prohibitive to most private students. The solid and drift editions of the Blair Atholl sheet, for example, cost *2l. 7s. 6d.*, and these precious maps may be ruined by a single day's use in the field in wet weather. Moreover, however carefully these hand-coloured maps may be revised they are always liable to suspicion, and occasional errors and omissions are inevitable. The colour-printed maps are in every respect a great improvement. They are cheap, the colours are clear and fixed, and the geologist is no longer perplexed by patches which are uncoloured or of which the colour is doubtful. A useful innovation on two of the new maps is a series of vertical and transverse geological sections, which add greatly to their usefulness. One disadvantage of the Scottish maps compared with the new English series is their unwieldy size; they measure about two feet by two feet five inches, which is inconveniently large. This, however, is a detail which any purchaser of a map can remedy for himself, and will not detract from the congratulations of Scotch geologists to the officials of the Survey on having secured the boon of colour printing.

The three memoirs deal with two very different branches of Scottish geology. Sheet No. 71 comprises the districts around the Sleat of Skye. To the west it includes the eastern part of the Cainozoic volcanic series of Skye, with the gabbros of Blaven and the granophyre of Lord Macdonald's Forest; the eastern part of the sheet is occupied by the Archæan rocks, while a strip of Torridon sandstone with the southern end of the great thrust-planes of north-western Scotland traverse the middle of the map. The memoir on this district has been awaited with much interest, for many of the problems with which it deals are of wide importance. The area includes the well-known Archæan limestones to the east of Glenelg; it shows exceptionally well the relations between the Moine and Lewisian gneisses, and north of Glenelg Bay there is an interesting contact between the Torridon sandstone and the Moine gneiss.

The memoir marks one very important advance in the history of the Scottish Archæan geology. It has

FIG. 1.—Intrusive Sheet of Teschenite, with Upper Old Red Sandstone in the Foreground, Salisbury Craigs, Arthur's Seat, Edinburgh. From "The Geology of the Neighbourhood of Edinburgh."

[1] The Geology of Glenelg, Lochalsh and South-East part of Skye. (Explanation of one-inch map 71.) By Dr. B. N. Peach, F.R.S., and others. With contributions by G. Barrow and others. Pp. x+206 and map. Price 3*s*. 6*d*. Memoirs of the Geological Survey, Scotland.

The Geology of the Neighbourhood of Edinburgh. (Sheet 32, with part of 31.) By Dr. B. N. Peach, F.R.S., and others. Contributions by Dr. J. Horne, F.R.S. and others, and Petrological Chapters by Dr. J. S. Flett. Second edition. Pp. xii+445+xii plates and map. Price 7*s*. 6*d*.

The Geology of East Lothian, including parts of the Counties of Edinburgh and Berwick. (Explanation of sheet 33, with parts of 34 and 41.) Second edition. Revised and re-written by C. T. Clough and others. With contributions on the Silurian Tableland by Dr. B. N. Peach, F.R.S., and Dr. J. Horne, F.R.S. Pp. x+266+xii plates and map. Price 4*s*. 6*d*. (Edinburgh: W. and A. K. Johnston, Ltd.; London: H.M. Stationery Office, Edward Stanford, and T. Fisher Unwin; Dublin: Hodges, Figgis and Co., 1910.)

been a widespread belief that the Moine gneiss is the metamorphosed eastern representative of the Torridon sandstone, a view supported by the high authority of Dr. Peach. The memoir does not accept that view, and leaves the decision somewhat uncertain. The Moine series is described on the map as of uncertain age, but it is placed below the Torridonian, from which it is separated by a series of igneous rocks, and it is placed just above the Lewisian. The guarded statements in the text and the association of the Moines in the explanation of the map with the Lewisians rather than the Torridonians, both suggest that the final conclusion of the Survey inclines strongly to the view that the Moines are pre-Torridonian. The relations between the Moine and the Lewisian gneisses is another problem on which there is a strong difference of opinion, and the neighbourhood of Glenelg yields important evidence on this question. The subject is carefully discussed in the text, and the conclusion is adopted that the Moines are a younger series, resting unconformably on the Lewisian, the junction being marked in places by a basal conglomerate.

The problems dealt with in this memoir are of unusual variety, for the area includes a wide band of the Torridonian, the Cambrian limestones with their interesting metamorphic structures south of Broadford in Skye, a varied series of Mesozoic rocks, ranging from the Trias to the Upper Cretaceous, and the eastern part of the famous Cainozoic volcanic series of central Skye.

The two other memoirs are both new editions, and describe better known and more accessible areas. The memoir on sheet 32 is issued as a new edition of "The Geology of Edinburgh." This edition is necessarily enlarged, and is now a work of 450 pages with twelve excellent plates, a coloured map of Arthur's Seat, and other illustrations. The new edition contains many important alterations, for its predecessor was issued fifty years ago. The subject of most general interest in this sheet is the ancient volcano of Arthur's Seat. The work of the Survey has confirmed many of the conclusions of Sir A. Geikie, especially his explanation of the basic lavas of Calton Hill as a part of the volcanic platform of Arthur's Seat, which has been faulted westward. Prof. Bonney's separation of the sill of Salisbury Crags, now identified as teschenite, from the other igneous rocks is accepted, and Prof. Judd's theory that the volcanic rocks of Arthur's Seat all belong to one series of eruptions is fully established. The sedimentary rocks have also undergone great changes; the Craigmillar sandstones that underlie the volcanic rocks, are transferred to the Old Red Sandstone, a view first suggested by Goodchild, who held that their lithological characters were inconsistent with the climatic conditions that prevailed in the area during Carboniferous times. This argument has now been established by Dr. Traquair's identification of some fossil fish remains which were first found by Dr. Peach.

FIG. 2.—Typical Dry Valley joining Spott Burn, above Spott. From "The Geology of East Lothian."

The geology of the country to the west of Edinburgh has undergone even greater changes. When that part of the sheet was mapped in 1859 there was no oil shale mining in the district; the discovery of the West Lothian oil shales and the development of the mineral oil industry has all happened since the first edition was issued. There is also much fresh

evidence as to the coal supply of the area, and the memoir quotes the estimate of Dr. Dixon and Mr. John Gemmell that, at the present rate of consumption, there is sufficient coal in seams of one foot or more in thickness to last for another two thousand years.

The Edinburgh area is rich in fossils, and the interesting palæontological sketch and the tables by Dr. Lee are among the most useful contributions in the volume. There is a detailed bibliography by Mr. Tait. One remarkable omission from the literature of the areas is the absence of reference in any of the Survey memoirs to Bertrand's papers on the structure of the Scottish oil shale.

The third memoir deals with the geology of East Lothian, the district to the east of Edinburgh. Its geology includes part of the Silurian tableland of the Southern Uplands, of which the account is mainly taken from Peach and Horne's monograph on the Silurian rocks of Scotland. At the eastern foot of the Silurians is a wide plain of upper Old Red Sandstone, including at the base conglomerates containing such large boulders that Sir Andrew Ramsay regarded them as of Glacial origin. No support to this view has been obtained, and there is much more probability in Goodchild's view that the sandstones of the upper part of this system are a desert formation stained by the infiltration of iron from some once overlying beds of New Red Sandstone. The largest part of this sheet is occupied by rocks including two varied igneous series; the first consists of the lavas of the Calciferous sandstone series, and their associated necks, including trachytes, banakites, and mugearites, and the rare hornblende trachy-dolerites —to use that misleading term—known as kulaites. Bass rock is a neck belonging to this division, and the exposure of some fresher samples from it enables its rock to be identified as a phonolite-trachyte. The second igneous series includes the quartz-diabase, teschenite, and essexite, intrusive into the Carboniferous limestone series. The lowlands contain a varied series of Glacial deposits and some dry valleys described by Prof. Kendall and Mr. Bailey, cut during the recession of the ice (see Fig. 2).

Mr. Bailey contributes an interesting summary of the history of the scenery, and shows there is good reason to believe that the Midland Valley of Scotland originated as a true rift-valley, and that the scenery, though greatly modified during Glacial times, is mainly due to pre-Glacial denudation.

The areas described in these publications are of especial importance in Scottish geology owing to their varied problems, and the Geological Survey is to be congratulated on these valuable maps and memoirs, with the large amount of new evidence now so well placed at the public disposal. J. W. G.

PHYSIOLOGICAL APPLICATIONS OF RADIOGRAPHY.

It is a matter of common knowledge that the introduction of X-ray examinations of patients was a boon and a blessing both to patients and surgeons. The localisation of foreign metallic objects, such as bullets and needles, and the exploration of fractured bones and disorganised or dislocated joints, have been thus rendered both easy and certain.

It may not, however, be so generally known that it is also possible to render visible the movements of certain internal organs, which are sufficiently opaque to cast their shadow on the photographic plate or the fluorescent screen; it need scarcely be pointed out that in this way much more accurate information can be obtained of the movements of the heart and diaphragm than what was previously inferred from the examination of the cadaver, or the inspection of the exposed parts in anæsthetised animals.

Notable among the recent achievements in this direction are researches which have for their object the investigation of the digestive canal. Cannon's work in the Harvard laboratory a few years ago showed that in animals the journey of a meal mixed with bismuth salts can be followed with a nicety never before experienced. Valuable as this pioneer work was, it is comparatively unimportant from the human and practical point of view, when compared with the investigations which, by similar means, are possible in man. Here Dr. Hertz and his colleagues at Guy's Hospital have done yeoman service; and Dr. Hertz has embodied the bulk of his work in a very readable volume, entitled "Constipation and Allied Disorders" (London: Hodder and Stoughton, 1909). It is possible to administer to human beings sufficiently large doses of bismuth carbonate (2 to 6 ounces) without any detriment either to digestive processes or to the well-being of the subject of the experiment. Without going into the details of the time occupied in the various parts of the alimentary tract, and the nature of the peristalsis which is the cause of the downward progress of the food, it will be sufficient to say that we now possess trustworthy data on these and many other points, and the events from swallowing onward to defæcation have been examined and registered.

We have been led into these references by a reprint now before us by Dr. A. C. Jordan, who holds the office of Medical Radiographer to Guy's Hospital. It is entitled "Radiographic Demonstration of Lane's Ileal Kink," and this, to the non-medical reader, will not convey much. When man adopted the upright posture, the advantages he gained were, to a certain extent, counterbalanced by some disadvantages and a liability to certain troubles. One of these is that the abdominal viscera either drop, or tend to drop. The stomach, for example, has its greater curvature in the pelvis when a man stands upright, and the transverse colon (a part of the large intestine) hangs in a great loop, the middle of which accompanies the stomach into the pelvis. Mr. Arbuthnot Lane has shown that Nature attempts to diminish these changes of position of the viscera by the formation of adhesions, which form supplementary mesenteries to hold them up. But this attempt at a remedy is not entirely adequate, and kinks in the bowel may be produced, which lead to obstruction, giving rise to pain, to many days' delay in the passage of food, and severe constitutional changes, due to the absorption of toxic materials from the intestine. A part of the intestine called the ileum is particularly apt to be kinked in this way, and its surgical treatment will relieve the patient of all symptoms. A bismuth meal and subsequent radiographic examination will reveal the situation of the kink, and so the surgeon knows exactly where to cut down, and the patient has only to suffer from a comparatively small abdominal wound.

We may take such work as an admirable example of the practical and beneficent application of the X-ray method to structures which are neither bones nor foreign objects such as bullets. The members of the Guy's Hospital staff responsible for these results are to be heartily congratulated on the outcome of their researches, and the public at large owe them a deep debt of gratitude in addition.

SIR RUBERT BOYCE, F.R.S.

THE news of the premature death of Sir Rubert Boyce, at the age of forty-eight, will come as a shock to many, not only at home, but throughout the tropical world. A bare record of his scientific work would give but little idea of what his achievements really were. His rare abilities were of a practical nature, and took shape eventually in the initiation and organisation of manifold activities. He was educated in London, Heidelberg, and Paris, and after taking his medical degree in 1889 he devoted himself to research work, mainly on the pathology of the nervous system, under Sir Victor Horsley, at University College, and in 1893 was appointed professor of pathology at the then University College, Liverpool. Soon afterwards he was asked to take up the position of bacteriologist to the city of Liverpool, which he held until his death.

In 1902 Sir Rubert Boyce was elected a Fellow of the Royal Society. He was a member of the Royal Commission on Sewage Disposal, and for a period of five years he supervised the researches conducted for the Commission at Liverpool. In 1904 he was appointed a member of the Royal Commission on Tuberculosis, and on the day of his death he was to have signed the final report of the Commission.

During these years his powers of organisation were being put into practice, and to mention one project only, his part in the transformation of University College into the University of Liverpool is a well-known fact. While this and many other achievements—for in each he took a most active part—represent an amount of work and energy that can only be appreciated by those who know the manifold difficulties and the dead weight of opposition that has to be removed before such objects can be successfully carried through, yet they were still to be followed by even greater things.

Sir Rubert Boyce had established a close relationship, often indeed a warm friendship, with those other great organisers who mould the destiny of the great commercial world of Liverpool. He was never tired of telling the commercial community that science was not merely an academic pursuit, but was intimately connected with the carrying on of their business. Whilst he preached that science was not merely an academic pursuit, his practice was a proof of it. One of the most remarkable and devoted of his friendships was with one of the most striking of the great personalities of Liverpool—the late Sir Alfred Jones. Sir Alfred himself was a man of great practical organising genius, and the great organising powers of Sir Rubert Royce now found their full scope in association with this untiring orginator of ideas. It was in 1898 that he, together with Sir Alfred Jones, founded the Liverpool School of Tropical Medicine, which rapidly became known throughout the whole world, both scientific and non-scientific, for its work. Now also at his initiative commenced that remarkable series of expeditions which, apart from their scientific side, fired the imagination of all residents in the tropics.

Tropical medicine was forced on the ear of the public, and their help and that of the governors in the tropical dependencies was enlisted, in securing that the conditions in the tropics should be improved. The improvement in the last ten years has been great, but the work has really only begun. Sir Ronald Ross had at this time been conducting his anti-malarial campaign, but there was more to be done, and Sir Rubert, not content with having founded a great school, himself actually went into the field to see matters at first hand.

In 1905 an outbreak of yellow fever occurred at New Orleans. He quickly availed himself of the opportunity, offered by the American authorities, to take part in the campaign. He then laid the foundation of that experience which was to bear fruit later. At the same time, at the request of the British Government, he visited British Honduras, where also yellow fever had broken out. In 1906 the first symptoms of the illness that eventually proved fatal occurred. In 1909 again, at the request of the Government, he visited the West Indian Islands to investigate yellow fever, and in 1910 he made his last expedition to West Africa, where an epidemic of yellow fever had occurred.

Not content simply with official reports of these expeditions, he determined to impress the importance of these subjects, of which yellow fever was only one, on the public. The result was in two short years three popular works, "Mosquito or Man," "Health Progress and Administration in the West Indies," and "Yellow Fever and its Prevention," stating in clear and forcible language the bearing of scientific results on the health and prosperity of the community. The success of these works was immediate, and the name of Sir Rubert Boyce became a household work to every European in the tropics. But even this was not enough; he must do something to remedy the state of affairs revealed, and the formation of the Bureau of Yellow Fever at Liverpool marks the last of his many practical works. It is as a great scientific organiser that Sir Rubert Boyce will take his place, and when the history of tropical medicine comes to be written, his will be a foremost and revered name.

In tropical medicine it may well be said that he found the passion of his life. The founding of the school may be regarded as the culminating effort of his practical genius, but his actual experience of tropical medicine in the field, in his visits to the tropics, so impressed his imagination that it is impossible to think he ever would have forsaken it; and, very shortly before his death, which he knew might take him at any moment, he declared that his one desire in life was to do some work to alleviate the condition of those who lived in the tropics. His methods came as a sharp electrical shock to those accustomed to more sedate ways. Financial difficulties seemed to present to him no obstacle, once he had seen that the end was desirable; his unrivalled success in collecting funds from the most unpromising quarters was well known, and he will be sorely missed not least by those who suffered gladly in this way at his hands.

His care and thought for those who worked with him were often unsuspected, but those who did their work thoroughly found that they were not forgotten in the race, and there are many in various parts of the world who can testify to his generous help.

His many activities often aroused keen antagonisms, and to many perhaps his personal qualities were quite unknown. But those who knew him in his private life, who had enjoyed his hospitality, or had further had the privilege of his friendship, found in him a warm, generous, and noble spirit.

J. W. W. S.

SCIENCE AND CORONATION HONOURS.

OWING to the necessity of going to press earlier than usual last week no reference was made to the list of Coronation honours. There is, however, little to record; for though the list is very long, the services which men of science render to the State are but scantily represented in it. From a national point of view this disregard of scientific work must be considered as unenlightened policy. A title does not

usually add much to the distinction of the man of science upon whom it is conferred, but it indicates that the State regards his work as worthy of public honour and encouragement. No greater services can be rendered to the nation than those represented by contributions to natural knowledge, but judging from the list of honours they are least esteemed. The reason is probably that men of science of distinguished eminence are as unknown in the political world as most of the names in the list are unknown outside particular circles. It is apparently necessary to apply science to some art or profession before the State can understand its value. Many members of the medical profession are rightly included in the honours list, and we offer all of them our congratulations. Education also receives some recognition. We notice in the list the names of the following Fellows of the Royal Society:—

Dr. W. Osler, Regius professor of medicine in the University of Oxford, has been made a baronet; Dr. A. J. Evans, honorary keeper of the Ashmolean Museum, has been knighted; the Hon. C. A. Parsons, C.B., has been promoted to K.C.B., and the same title has been conferred upon Major Ronald Ross, professor of tropical medicine in the University of Liverpool, Vice-Admiral A. M. Field, lately hydrographer of the Navy, and Prof. J. A. Ewing, director of naval education. Mr. R. E. Froude, superintendent of the Admiralty Experimental Works; and Prof. A. W. Reinold, late professor of physics in the Royal Naval College, Greenwich, and Colonel H. C. L. Holden, superintendent, Royal Gun and Carriage Factories, Woolwich Arsenal, have been created C.B.'s. Dr. J. Rose Bradford, secretary of the Royal Society, has been appointed a K.C.M.G.

Omitting representatives of medicine in its various branches, other names familiar to many of our readers are:—

Sir John Rhys (Privy Councillor); Sir Boverton Redwood (Baronetcy); Dr. A. W. W. Dale, Vice-Chancellor of the University of Liverpool, Mr. G. H. Ryan, president of the Institute of Actuaries, Dr. J. E. Sandys, Public Orator in the University of Cambridge, and Prof. R. P. Wright, lately professor of agriculture and principal of the West of Scotland Agricultural College (Knighthoods); Prof. M. E. Sadler, professor of education, University of Manchester (C.B.); Dr. R. A. Falconer, president of the University of Toronto, Mr. H. N. Ridley, Director of Gardens and Forests, Straits Settlements, and Dr. T. Zammit, Government analyst, Public Health Department, Malta (C.M.G.'s).

NOTES.

It is now an open secret that the intentions of Parliament for the investigation and cultivation of the local fisheries are being greatly delayed by the apparent reluctance of the Board of Agriculture and Fisheries to cooperate with the Development Fund Commissioners. Questions asked in the House of Commons during the last few months have elicited replies which show that a carefully drafted application, made more than a year ago, by the Lancashire and Western Counties Fisheries Committee, containing definite proposals for the improvement of the local fisheries, has not yet been submitted to the commissioners. On June 20 Sir E. Strachey, replying to Mr. N. Buxton and Mr. Whitehouse, assured the House of Commons that the Board is not neglecting the fisheries. It has applied to the Development Fund Commissioners for a loan of 50,000*l.*, and an annual grant of 8000*l.* for the purpose of coast patrol vessels. It is also asking for a sum of money to enable a special commission to investigate the condition of the inshore fisheries. The secretary to the Board should also have stated that, during the last nine years, two Departmental Committees have made exhaustive reports with regard to the inshore fisheries, and that the Board has now full control of the staff, funds, and resources for fishery investigation enjoyed by the Marine Biological Association until about a year ago. Further, it was not made clear that the subjects mentioned by Mr. Buxton—the investigation of the shell-fisheries and the pollution of tidal waters, the scientific investigation of the territorial water fisheries, and the organisation of the research societies—have all been considered by the fishery committees wherever these things are important enough to require consideration. The urgent need of the present time is that the Development Commissioners should assist the local committees in the prosecution of investigation and cultivation of the inshore fisheries.

The annual report of the Society for the Astronomical Study of Ancient Stone Monuments, Cornwall Branch, shows increasing membership and funds. The report consists mainly of a paper read by Mr. Henry Thomas, one of the secretaries, reviewing observations made at Boscawen-un, Tregaseal, Wendron, and Boskednan circles. In each case the typical circle "does not constitute or comprise in itself a system, but that it is rather the centre of a system, and that the number of stone monuments and barrows which stand at various distances and in various directions, but all within sight of the circle, were not erected and constructed in those positions by mere accident" is "one thing about which there can be no division in our opinions." The circles are never exactly alike, and it seems that not one of those examined is a true circle. It is confessed that no rule has been found to explain the varying distances between the stones in a circle. The apparent irregularity suggests the direction in which a rule might be found, namely, testing the astronomical use of each stone from all available view-points. The next meeting of the society is announced to be held at Rosemoddress Circle, St. Buryan, on June 30.

The late Prof. His, of Leipzig, conceived the idea of establishing in each country a central institute which should have for its chief aim the organisation and the coordination of biological research in its own territory, and serve as a means of cooperation with similar institutions in other countries. In other words, his far-reaching scheme implied the establishment of a regular organised army to attack the problems of living matter, which are being assailed at present only by the wasteful methods of guerilla warfare. During the last decade this proposal has been put to a practical test in the United States and Europe (excepting Great Britain) by the establishment, or the recognition, of certain institutions as centres for coordinating researches upon the brain, under the direction of the "Brain Commission" of the International Association of Academies. The success already attained in this domain of biology has encouraged others to follow in the footsteps of the neurologists. During Whit-week a conference was held in the zoological laboratory of the University of Utrecht for the purpose of founding an International Embryological Institute. Austria, Belgium, England, France, Germany, and Holland were represented at the meeting by workers in the domain of vertebrate embryology; and letters were received from Switzerland and the United States in support of the scheme adumbrated by the conveners of the meeting. Prof. R. Bonnet, of Bonn, was elected first president of the institute, and it was decided that the first aims of the new institution should be (1) the collection of complete series of well-preserved embryos of every mammalian order, and (2) a more intimate cooperation between embryologists, for the purpose of attaining a uniformity in nomenclature and the solution of the special difficulties in this field of investigation.

THE German Emperor has conferred the Order of the Crown, Second Class, upon Sir Ernest Shackleton.

DR. SVEN HEDIN has been elected a correspondant of the Paris Academy of Sciences in the section of geography and navigation.

THE death is announced, in his fifty-fifth year, of Dr. E. B. Voorhees, the director since 1896 of the New Jersey Agricultural College experiment station, and the president, since 1901, of the New Jersey State Board of Agriculture. He had written and lectured extensively on agricultural chemistry and allied subjects.

AT the meeting of the Association Internationale de l'Institut Marey held on June 6th, the resignation of Prof. Kronecker as president was received. The members of the association elected Prof. Charles Richet as president, and Dr. Augustus D. Waller as vice-president. The Institut Marey is under the patronage of the Associated Academies. It is situated in the Parc des Princes, Boulogne-sur-Seine, Paris, and contains laboratories, library, and living rooms for the accommodation of workers. The acting director is Dr. Lucien Bull.

THE Royal Institute of British Architects has awarded the King's gold medal for the promotion of architecture to Dr. W. Dörpfeld, director of the German Archæological Institute, Athens. Owing to Dr. Dörpfeld's serious illness, he was unable to receive the medal in person at the meeting of the institute on June 26, and he has had to abandon his projected visit to this country, in the course of which he was to receive an honorary degree at Cambridge, and speak at a special meeting of the Hellenic Society on July 4.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—(1) A research into the causes of premature arterial degeneration in man, by Dr. F. W. Andrewes; (2) an inquiry by Dr. J. H. Thursfield into the causes of death in measles; (3) a comparison by Prof. Nuttall, F.R.S., of the number and kind of fleas found on rats; (4) a continuation by Dr. C. J. Lewis of his investigation into the degree of prevalence and the characteristics of micro-organisms known as non-lactose fermenters in the alimentary canal of infants; (5) an investigation into the same subject by Dr. D. M. Alexander; (6) an inquiry by Dr. Graham Smith into the incidence of non-lactose fermenters in flies in normal surroundings and in surroundings associated with epidemic diarrhœa; (7) a study by Dr. F. A. Bainbridge of the anærobic bacteria in the alimentary canal of infants; (8) an investigation by Dr. Graham Smith into the possibility of pathogenic micro-organisms being taken up by the larva and subsequently distributed by the fly.

THE council of the Royal Society of Arts has decided to make the following awards in connection with the prize offered for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious:—a gold medal to Mr. H. A. Fleuss, for the apparatus submitted by Messrs. Siebe, Gorman and Co.; a gold medal to Mr. W. E. Garforth, in recognition of his efforts to perfect and to secure the adoption of rescue apparatus in mines; a silver medal for the "Draeger" apparatus submitted by Mr. Richard Jacobson; a silver medal for the "Meco" apparatus submitted by the Mining Engineering Company. Of the apparatus submitted to the committee appointed to report upon the subject, four depended on the supply of compressed oxygen, one on the provision of air evaporated from liquid air, and one on the production of oxygen from "oxylith." The principal points of difference, apart from the fundamental principles on which the apparatus are constructed, appear in the comparative lightness and convenience of carriage, and in the arrangements for enabling the wearer to breathe either by the use of a helmet or by means of mouthpieces of various construction. The committee does not consider that the liquid-air apparatus sent in is as yet sufficiently perfect to justify its adoption in preference to the older systems, under which oxygen is supplied from a receptacle containing the gas in a state of compression.

THE annual report of the committee of the Research Defence Society is a record of good work accomplished during the past year. The total number of members and associates, which was about 3360 a year ago, is now about 4600, showing an increase of 1240, as against an increase of 840 in the previous year. There are now twenty-five branches, and this number is expected to be increased in the autumn. Since June of last year more than ninety addresses or lantern-lectures connected with the society have been given in different parts of the kingdom. The following pamphlets and leaflets have also been published:—(1) report of annual general meeting, 1910; (2) Malta fever; (3) sleeping sickness; (4) experiments on dogs; (5) In Memoriam, Louis Pasteur; (6) the facts of the case; (7) experiments during 1909; (8) humanity and science, by the Bishop of Ely; (9) plague in India, by Colonel Bannerman; (10) friends of animals, by Major Marjoribanks; (11) a question of ethics, by Major Marjoribanks; (12) the case presented by the anti-vivisectionists, by Prof. Schäfer. The quantity of literature distributed has greatly increased during the year. Five hundred copies of Colonel Bannerman's pamphlet have just been supplied to the Government of Eastern Bengal and Assam. The total number of pamphlets and leaflets distributed during the year was more than 150,000. A book is in the press giving a full account of the evidence before the Royal Commission. Of course, with all this increase of work, there has been a considerable increase of expenditure, and the committee earnestly appeals to all members and associates of the society to enlist their friends, and thus to extend still further the society's useful work. The honorary secretary, to whom in great measure the success of the society is due, is Mr. Stephen Paget, 21 Ladbroke Square, W.

IN No. 5 of vol. v. of *The American Museums' Journal*, Prof. H. F. Osborn gives an account of an important extension of the American Museum of Natural History, New York, which is to be undertaken shortly. This is nothing less than the erection of a new eastern façade, similar in general character to the southern façade, but somewhat simpler in design. It will contain a second main entrance to the building. When this addition is completed, it will permit of the installation of an extensive ethnographical and also a zoological series arranged geographically. It is also contemplated to arrange a gallery illustrative of the sequence of human evolution; while eventually it is intended that astronomy, geography, and oceanography should be included in the exhibition series.

THE Museo Nacional of Buenos Ayres publishes in vol. xx. of its *Annales* two papers by M. Florentino Ameghino, one entitled "Observations au sujet des notes

du Dr. Mochi sur le paléoanthropologie Argentine," the second, "L'Age des formations sédimentaires tertiares de l'Argentine en relation avec l'antiquité de l'homme." In the first, while admitting Dr. Mochi's services to the cause of prehistoric archæology, the writer, whose paper is fully illustrated by drawings of skulls, conducts a lively criticism of Dr. Mochi's views. This is renewed in the second paper, in which he arrives at the conclusion that the presence of Archtotherium in the quaternary deposits of North America furnishes an additional proof of the immense antiquity of the Pampean and other ancient formations in Argentina, which contain the *débris* of animals of the same group.

In the study of the native languages of the American continent, Mr. A. L. Kroeber, in a paper entitled "Phonetic Constituents of the Native Languages of California," contributed to vol. x. of the publications on American archæology and ethnology of the University of California, has opened up new ground. Hitherto some of the most valuable grammatical study of these tongues has been conducted by ethnologists untrained in phonology. Recently, however, the principles and methods of phonetic research established by European scholars have been applied to the languages of the American Indians, and in this paper the results, already promising, are discussed. This investigation will, it is hoped, not only assist in the study of those Californian dialects which have not been as yet examined, but will help to solve the fundamental problem, whether the linguistic families of America possess any underlying or general features peculiar to themselves as a class.

The Somerset Archæological and Natural History Society has resumed work on the Meare Lake village, under the control of Messrs. A. Bulleid and H. St. George Gray. Besides various late-Celtic relics similar to those already discovered, Mound 7 has produced a class of objects hitherto not found elsewhere, including a number of worked and polished shoulder-bones of animals, the blade-bones being in some cases ornamented in the dot-and-circle pattern. Kimmeridge shale is rather plentiful for a substance imported from Dorset. Little bronze has so far been found, the objects including finger-rings, an awl, and a rivet. Some much-corroded iron objects, such as a knife and chisel, have been unearthed. Human remains are scarce, only two pieces of skull-bone having been found. Pottery is plentiful, and of a type differing in design from that found at the Glastonbury Lake village. As is evident from the number of bones of various kinds, the people occupying this site lived largely on meat. They possessed an ox and horse of a small type, a large variety of dog, and remains of the beaver and otter have been discovered. The relics which have been up to this time found are open to inspection at a temporary museum on the site, whence later on they will be removed to the County Museum at Taunton Castle.

The Edinburgh Medical Journal for June (vi., No. 6) is a centenary number dedicated to the memory of Sir James Y. Simpson, "to whose genius and benevolence the world owes the blessings derived from the use of chloroform for the relief of suffering." It includes a number of portraits and other illustrations, and articles on his life and work by his daughter, Miss Eve Simpson, Sir Alexander Simpson, Sir Halliday Croom, Dr. Berry Hart, and others. Not only did he introduce chloroform, but in addition the uterine sound, mechanical dilatation of the cervix uteri, and various obstetric and gynæcological operations. He was a great and lovable man, and also engaged in the pursuit of many archæological problems.

Livingstone College, Leyton, E., was founded in order to give elementary medical training to missionary workers, and judging by the matter contained in the Coronation number of its year-book, just issued, appears to be admirably fulfilling its functions. Among the achievements of old students may be noted the action of the Rev. E. W. T. Greenshield, who rescued the entire shipwrecked crew of a Dutch whaler in which he was sailing, and for this he has been decorated by the Queen of Holland; whilst in Assam an old student, a missionary of the Baptist Missionary Society, has discovered a new mosquito, henceforth to be known as the *Culex pettigrewii*.

Hides and skins coming from some parts of the world, *e.g.* Siberia, China, Persia, and Asia Minor, are liable to be infected with anthrax, and those handling them are liable to infection. Many methods have been suggested for treating the skins so as to destroy the anthrax spores without damaging the material, but none is satisfactory. In a valuable report to the Leathersellers' Company, Dr. Constant Ponder discusses the incidence of anthrax amongst those engaged in the hide, skin, and leather industries, and has investigated various processes proposed for the sterilisation of anthrax spores. Among these, a process recently introduced by Mr. Seymour-Jones has been tested. It consists in soaking the skins for twenty-four hours in a solution containing 1 per cent. of formic acid and 1 in 5000 of mercuric chloride, after which the skins are treated with a strong brine solution. The method has no deleterious action, the skins can be perfectly tanned afterwards, and it is generally efficient in destroying anthrax spores. Probably a slightly increased amount of mercuric chloride would be an advantage.

After a long period of quiescence, plague has once more appeared among the rats in the Port of London. As mentioned in a note in Nature of June 22 (p. 562), plague-infected rats have been found for three years in succession in the port, viz. in the West India, the South-West India, and the Royal Albert, Docks. The present site of the infection is a wharf on the banks of the Thames at Wapping, less than a mile from the Tower Bridge. Twelve dead rats were found at this wharf, of which four at least were plague-infected. The existence of plague in wharves and warehouses, which are not inhabited at night, may be regarded with comparative equanimity so long as it does not spread to the rats in the plexus of mean streets which lie behind. The real cause for anxiety is the steadily widening area over which plague-infected rats have now been found. The fact that no cases of human plague have lately been recorded in England is not of much significance, because the period for human infection is only now commencing, coinciding as it does with the increase of the rat-fleas. A writer in *The Times* of June 17 in an able article thus summarises the occurrence:—"While the recurrence in the Port of London of an infection which has been already noted in three successive years can be regarded without excitement, it has its serious aspects. It cannot be too strongly urged that the mere presence of plague in England among rats, in however limited a form, may become a matter of sinister importance. If the Wapping outbreak marks a slowly widening circle of infection, it would be in exact accord with Indian experience, for plague has sometimes taken months, or even years, to pass through the rats of a single village. So long as the rats are infected, there must always be some danger to mankind."

The second number of vol. iv. of the Journal of the Federated Malay States Museums contains four papers, by

Mr. C. B. Kloss and other naturalists, on local mammals and birds.

WE have to acknowledge the receipt of the report of the Field Museum of Natural History, Chicago, for 1910, in which it is stated that a steady development of that institution is in progress, with a continued increase of its utility as an educating centre. A marked extension took place during the year in the anthropological department. The report contains several illustrations, among which attention may be directed to a photograph of a group of three gorillas recently added to the exhibition series.

POULTRY-BREEDERS should be interested in an article on the inheritance of fecundity in domesticated fowls, contributed by Dr. Raymond Pearl to the June number of *The American Naturalist*. The article is so full of technicalities that it is difficult to give a summary of the conclusions intelligible to the ordinary reader. The author is however, of opinion that different degrees of fecundity are inherited by fowls, although it is extremely difficult, if not impossible, to isolate and develop a strain with great egg-laying capacity. It is further stated that the inheritance is probably in complete "accord with Johannsen's concept of genotypes." It may be added that the "genotype," or "pure line theory," is discussed in a second article in the same issue by Dr. J. A. Harris, who is disposed to doubt its validity.

VOL. xiii. of the *Rapports et Procès-Verbaux* of the International Council for the Exploration of the Sea contains the administrative report of the eighth year (1909–10) of the international cooperation and the proceedings of the ninth meeting of the council, which was held in Copenhagen in September, 1910. Special interest attaches to the presence at this meeting as guests of the Deputy-Commissioner of Fisheries for the United States of America, Dr. Hugh M. Smith, and the Inspector-General of Fisheries for France, M. Fabre Domergue. It would be of the very greatest value to the success of the investigations if the area to be explored could be extended to the waters of the North Atlantic, with the cooperation of the French and American Governments. The reports, which are appended to the proceedings of the meeting, are of considerable importance, although the general report on plaice fisheries, which it is hoped will bring to a head much of the most important work which has been carried out in connection with the investigations, is not yet available. Dr. Hoek gives a summary account of the quantitative distribution of the eggs and larvæ of the gadoids in the North Sea, and Prof. D'Arcy Thompson furnishes a second report on the later stages of these fishes. The flat fishes are similarly treated by Dr. Ehrenbaum and Dr. A. T. Masterman.

THE REV. HILDERIC FRIEND has reported to the director of Kew Gardens the discovery of two new annelids in earth received from Peru. The first is an Enchytræid, *Fridericia peruviana*, Friend, the other being a new species of Trigaster. It differs from the known species in its small dimensions, as well as in the position of the gizzards, the hearts, and the intestine, and is named *Trigaster minima*, Friend. This worm has the gizzards in segments 9, 10, 11, the principal hearts are in 12–15, and the intestine begins in 19, while the length is 15 mm., as compared with 250 mm. in *Trigaster lankesteri*, Benham.

IN NATURE of May 11 (p. 356) attention was directed to the proposal of the Bombay Natural History Society to start an investigation into the mammals of British India. Mr. N. Annandale writes from Calcutta to point out that a real zoological survey, in which the more obscure groups of animals (which have no less scientific value than the mammals) were included, would cost a great deal more than 2000*l*., for which an appeal was made, although preliminary work has been done as regards certain groups. He refers to Colonel Alcock's recent memoir on the fresh-water crabs, which it is hoped will be followed shortly by others on different groups of terrestrial and aquatic organisms.

IN *The Journal of Economic Biology* (vol. vi., No. 2) Mr. E. E. Green presents an enumeration of several species of Coccidæ, with diagnoses of those new to science, collected on rubber plants in Ceylon. *Lecanium viride* was the most important found on *Hevea brasiliensis*, but as it occurred chiefly on young trees it was amenable to treatment by spraying. A new species, *Inglisia castilloae*, was perhaps the most dangerous, as it spread from the Castilloa to tea shrubs in the vicinity, but it did not attack the closely adjacent Hevea trees. Another of the new species is a lac insect that spread thickly on a Landolphia vine. A second item of interest to entomologists is supplied by the article in which Mr. H. Maxwell-Lefroy offers advice on the training of British entomologists, with special reference to students prepared to take service in British colonies or possessions. He insists particularly on the desirability of infusing a more "economic" character into the student's training.

THE interesting account of his botanical expedition to Lower Siam communicated by Mr. H. N. Ridley is continued in *The Gardener's Chronicle* (June 17 and 24). Many new or remarkable plants were collected near Kanga, in the province of Perlis. Three species of Holarrhena, small apocynaceous shrubs, a Dischidia, and a dwarf Lastræa are new to science; *Cycas siamensis*, characterised by its curved white stems, and a swollen-stemmed balsam, *Impatiens mirabilis*, were particularly striking as they grew on the limestone hills, and the orchid *Dendrobium crumentatum*, which flowers simultaneously over a whole area, was observed on its flowering day. Further north, near Setul, several Australian types were discovered, the most remarkable being a new species of Thysanotus, a liliaceous genus confined to Australia except for one Philippine species. The author concludes that the boundary between the Malayan and Burmese flora is unusually distinct, and lies near the town of Alorstar in Kedah.

A PRELIMINARY study of the flora on different grass plots, with the object of ascertaining whether a botanical criterion of their value as pasture lands can be evolved, is reported in the Scientific Bulletin (No. 2) of the Royal Agricultural College, Cirencester. A complete catalogue of species was first compiled, and then the species were arranged under the three groups of grasses, Leguminosæ, and general plants according to their relative abundance. Data were thereby obtained for a comparison of the proportion of valuable grasses and leguminous plants to the less valuable and worthless species. Thus it was found that where the bottom grasses were luxuriant only nineteen species in all were recorded, whereas the total number of species exceeded fifty on the poor lands. Also generalisations are deduced from the growth of allied species; thus *Bromus erectus* was strongest on the dry oolitic soil, while *Holcus lanatus* predominated on wet areas.

IN an interesting report on the "Barometer in Jamaica," Mr. Maxwell Hall discusses the determination of the differences of height between pairs of stations in Jamaica from meteorological observations, and he calculates certain tables for use in the application to this problem of a form of Laplace's formula slightly different from that usually

adopted. Mr. Hall finds differences in the values obtained for the height according to the time of day and the season of the year at which the observations of pressure, temperature, and humidity are made. The values are generally larger near midday and in summer than at other times and seasons, a result not altogether surprising. The temperature enters into the determination of height through the expression $\int_{z_1}^{z_2} \frac{dz}{T}$, and there is clearly room for error if this is taken to be $(z_2-z_1)/T_M$ where $T_M = \frac{1}{2}(T_1+T_2)$ and T_1, T_2 are the temperatures at the lower and upper stations respectively. Mr. Hall elaborates an empirical method for correcting the value of T_M obtained in this way, in order to eradicate the differences found. In this connection it may be mentioned that recent determinations of heights in the Tyrol have furnished results closely agreeing with the values obtained by levelling. In these cases, however, mean values were used, and an intermediate station was available. Mr. Hall uses the value 60,159 feet in the hypsometric formula, instead of 60,369 feet, the value adopted in the International Tables, but does not state his reason for preferring the smaller value.

IN *The Electrician* for June 9, Dr. R. Beattie describes a method of determining the coefficients in the Fourier series for a curve, which should extend the use of such series amongst those who have not had a mechanical analyser at command and have been unwilling to go through the laborious process of determining the coefficients arithmetically. It will be remembered that the latter process consists in measuring the ordinates of the curve at regular intervals, multiplying these by the sines or cosines of certain angles, and taking the mean of the products. Dr. Beattie's suggestion is to measure the ordinates on scales graduated so as to read the products direct, and thus reduce the work to addition. Once the necessary scales are available the method will, we anticipate, be used extensively.

THE Department of Commerce and Labour, Coast and Geodetic Survey, Washington, has issued a volume of "Directions for Magnetic Measurements," by Mr. Daniel L. Hazard, of the Division of Terrestrial Magnetism. This extends to 131 pages, and contains instructions for the absolute observation of the magnetic elements with instruments of the various types used by the Coast and Geodetic Survey. The instruments are described with illustrations, and there is a discussion of the determination of the several constants. This is followed by a series of "directions for operating a magnetic observatory," which includes an account of Eschenhagen magnetographs and the methods of standardising the curves. At the end there are a series of tables intended to assist in the reduction of the absolute observations, which include some particulars of the diurnal inequalities recorded at the observatories belonging to the Coast and Geodetic Survey.

THE U.S. Coast and Geodetic Survey's "Results of Magnetic Observations made . . . between July 1, 1909, and June 30, 1910," gives in about seventy pages an account of a year's work in terrestrial magnetism in the United States. Observations were made at 241 stations, including a number previously occupied, so that numerous secular change data were obtained. A good many magnetic observations were also made at sea by the Survey's vessels. Two-thirds of the space is devoted to descriptions of the stations occupied. The situation of some of these seems a little unusual. Several, for instance, are in cemeteries, the exact site being marked by small pillars dated and lettered U.S.C. and G.S., the coordinates of which in some cases are given in terms of the distances from adjacent tombstones. If the absence of iron can be relied on, and sentiment does not count, it cannot be denied that a good deal can be said in favour of the practice, but one rather wonders how it strikes the average unscientific American.

THE June issue of *Terrestrial Magnetism and Atmospheric Electricity* contains particulars of comparisons of magnetic instruments made by observers of the Carnegie Institution, Washington, between 1905 and 1910, at a number of stations in North and South America, Asia, Australia, and Europe. It also gives voluminous lists of data which the editor, Dr. Bauer, has received from a number of observatories in response to a request for information as to the exact times of commencement of fifteen magnetic disturbances which occurred between 1906 and 1909. The object is to settle a controversy which took place recently in the columns of NATURE as to the rate of propagation of these disturbances round the earth. A further list of data is to appear in the next number of the magazine. The discussion by Dr. Bauer will be awaited with interest. In a reference to the meeting of the International Meteorological Committee, held last September in Berlin, the removal of atmospheric electricity from the domain of the Commission on Terrestrial Magnetism is adversely criticised. A reference to the "passing of the Kew Magnetic Observatory" leads to the statement that "the testing and standardising of magnetic instruments is shortly to be turned over to the National Physical Laboratory." This seems rather in want of explanation.

A CORRESPONDENT asks where he could obtain a portable and very sensitive instrument with which to measure the acceleration of gravity. In reply to the inquiry, Dr. C. Chree has been good enough to provide the following information :—"The determination of *absolute* values of g (acceleration of gravity) with high precision is an attempt very rarely made. For a good many years past relative determinations have almost all been made with half-second pendulums. The half-second pendulums originally obtained for the Indian Survey, which were swung at Kew in 1903, are described in Major Lenox Conyngham's paper on the subject (Roy. Soc. Proc., vol. lxxviii., 1906, p. 241) as 'made by E. Schneider, of Vienna, after Col. von Sterneck's design.' He also says: 'The clock belonging to the apparatus was constructed by Strasser and Rohde, of Glashütte; its pendulum, made by Riefler, of Munich, is of invar.' At the present moment Prof. Helmert, of Potsdam, is considered the leading authority on the subject. Of late years pendulums of invar have been tried at Potsdam, as temperature uncertainties in the field are amongst the most troublesome. The usual procedure is to swing the pendulums at a base station—*e.g.* the observatory at Potsdam—where g is supposed to be known, and thence to deduce its value at any other place where the pendulums are subsequently swung."

MESSRS. CASSELL AND CO., LTD., have commenced a reissue of Mr. W. F. Kirby's well-known "Butterflies and Moths of Europe," to be completed in thirty-two weekly parts. Part i. appeared on May 25.

THE Admiralty has ordered from Messrs. Newton and Co., of 3 Fleet Street, London, ten sets of X-ray apparatus to be supplied to the new battleships for service afloat. We understand that these will make altogether thirty complete installations that this firm alone has recently supplied to the ships of the Royal Navy.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY:—

July 2. 18h. 0m. The Sun in Apogee.
" 22h. 0m. Jupiter stationary.
3. 13h. 0m. Mercury in superior conjunction with the Sun.
4. 21h. 21m. Jupiter in conjunction with the Moon (Jupiter 0° 58′ N.).
7. 4h. 0m. Venus at greatest elongation, 45° 29′ E.
8. 2h. 10m. Mercury in conjunction with Neptune (Mercury 2 19′ N.).
11. 18h. 19m. Uranus in conjunction with the Moon (Uranus 4° 28′ N.).
14. 9h. 0m. Neptune in conjunction with the Sun.
19. 7h. 31m. Mars in conjunction with the Moon (Mars 2° 0′ S.).
20. 11h. 11m. Saturn in conjunction with the Moon (Saturn 3° 33′ S.).
" 18h. 0m. Uranus at opposition to the Sun.
24. 14h. 42m. Neptune in conjunction with the Moon (Neptune 5° 29′ S.).
26. 20h. 0m. Mercury in conjunction with the Moon (Mercury 4° 6′ S.).
28. 9h. 18m. Venus in conjunction with the Moon (Venus 5° 47′ S.).
29. 2h. 0m. Mercury in conjunction with α Leonis (α Leonis 0° 9′ S.).
" 13h. 0m. Jupiter at quadrature to the Sun.

REDISCOVERY OF WOLF'S COMET.—A telegram from the Kiel Centralstelle announces the rediscovery of Wolf's comet, by Prof. Max Wolf, on June 19. The position of the comet at 12h. 4·9m. (Königstuhl M.T.) was

R.A. = 18h. 46m. 16s., dec. = 13° 28′ N.,

and its magnitude was 15. The position is about 15m. west of ζ Aquilæ. According to the continuation of the ephemeris published by M. Kamensky in No. 4505 of the *Astronomische Nachrichten*, the comet will move in a north-westerly direction until July 15, when it will turn south again. Its calculated magnitude for July, September, and October is about 12·2, but from the observation the actual magnitude is, at present, somewhat fainter than the calculated.

MARS.—Observations of Mars were commenced at the Juvisy Observatory during the clear mornings of April, and several well-known features were seen. The south polar cap was seen to be surrounded by a dark belt, which certainly had the appearance of an objective phenomenon. Mare Sirenum was seen on April 24 as a diffuse spot descending from the polar cap and fading gradually towards the bright limb of the planet. The central region to the north was seen to have the accustomed yellowish-orange hue, and Titan was vaguely, but surely, seen. These observations when the apparent diameter of the planet was only 6″ show that useful observations will be possible considerably before the opposition, which takes place on November 25. The account of these early observations, in the June number of *L'Astronomie*, is illustrated by a drawing made by M. Quénisset at 16h. 20m. on April 24.

In *La Nature* (No. 1986, June 17) Dr. Mascart has an interesting illustrated article, in which he discusses the present state of the vexed question concerning the reality of the Martian canals. The general result is that the question is, as yet, by no means decided, but there is a hope that the laboratory experiments being carried on by MM. Chapeau and Danjon may do something to elucidate this difficult question further.

THE PROBLEM OF THE SOLAR MOTION.—Continuing the discussion with Prof. Comstock concerning the proper motions of faint stars, Dr. H. E. Lau publishes some interesting results, accruing from the Copenhagen measures of the Engelhardt stars, in No. 4502 of the *Astronomische Nachrichten*.

He finds that the mean proper motion of tenth-magnitude stars is 3″ per century at the most, and that it is smaller in the Milky Way than outside it. For the position of the apex he obtains A = 290°, D = +44°, and finds that the proper motions of tenth-magnitude stars indicate a greater R.A. and declination than those of the brighter stars, but the reality of this difference is still doubtful. A reduction of the measures shows that the mean parallax of these stars of the tenth magnitude lies between two and three thousandths of a second of arc, and that the error of Newcomb's precession constant does not exceed 0·1″ per century.

THE FORMS OF SPIRAL NEBULÆ.—The forms of spiral nebulæ is a matter of moment in any investigation concerning cosmical evolution, and any attempt to find some general law which these early systems follow is therefore of interest. Such a research is described by Herr Von E. v. d. Pahlen in No. 4503 of the *Astronomische Nachrichten*.

The author has studied photographs of many spiral nebulæ taken at the Lick and the Isaac Roberts Observatories, and has attempted to find general equations to their curves. Among other nebulæ, he has considered M. 33, Trianguli, M. 74, Piscium, and M. 51, Canum Venatici. In each case an Archimedian spiral was tried, but it was found that a logarithmic spiral could be found which better fitted the chief branches of the observed spirals. The agreement of the calculated and observed curves is shown by a number of graphs, and all are satisfactory except the second branch of M. 51, in which there appear several discordances. The paper also discusses the probable generation of such curves as are observed in these objects.

THE SPECTROSCOPIC BINARY *o* PERSEI.—*o* Persei is of special interest as a spectroscopic binary because, as occurs in one or two other cases, the calcium lines H and K do not appear to participate in the general variations of the radial velocity. In discussing the Allegheny observations of this star, Mr. F. C. Jordan pointed out that his value for the velocity of the centre of the system did not agree with the one obtained earlier by Vogel from the Potsdam observations, and suggested the possibility of a systematic personal error in the latter.

To clear up this point, Dr. Ludendorff has made new measures of the spectra, and finds that, although there is a marked difference between Vogel's measures and his own, yet it remains probable that the difference between Jordan and Vogel is to some extent real; possibly a third, as yet unconfirmed, body is included in the system. As the spectrum of *o* Persei is difficult to measure, further investigations will have to be made to settle this interesting point (*Astronomische Nachrichten*, No. 4500).

THE COAL-DUST QUESTION IN THE UNITED STATES AND IN AUSTRIA.[1]

THE first explosion that seems to have attracted attention to coal dust in the United States occurred at Pocahontas mine in 1884. Very little attention was paid to the subject for some years afterwards, until explosions began to occur in the western region "in shallow mines in which firedamp had never been found before the explosions, and was not found after them." Although the majority of these were not of a serious character, they gave rise to much uneasiness; but when what might be called the *black* year of 1907, with a death-roll of "1148 men killed by mine explosions," had run its course, uneasiness gave way to consternation. In 1908 Congress "made an appropriation" for the investigation of mine explosions, which became available on July 1; the United States Geological Survey was entrusted with the work, and an experimental station, which had, in the interim, been erected at Pittsburg, was officially opened on December 3 of the same year.

Experiments which, in the bulletin before us, are described as a preliminary series, have been made with the object of determining "the quantity or density of the finest size of coal dust necessary to propagate an explosion."

[1] "The Explosibility of Coal Dust." By George S. Rice, with chapters by J. C. W. Frazer, Alex Larsen, Frank Haas, and Carl Scholz. United States Geological Survey, Bulletin 425. Pp. 186. (Washington: Government Printing Office, 1910.)

Abstract of the Reports on the Austrian Coal-dust experiments conducted at the Rossitz experimental station 1908–1909 by k. k. Oberbergkommissär, Dr. Czaplinski, and Werksdirektor Jicinsky. Pp. 36. (London: The Colliery Guardian Company, Limited, 1911.)

The apparatus employed is similar to that at Altofts and Liévin. It includes a cylindrical gallery 6 feet 4 inches in diameter by 100 feet long, closed by means of a block of concrete at one end; with a cannon embedded in the concrete, from which shots can be fired for the purpose of raising and igniting the dust; with small glass windows at intervals of 6 feet 8 inches apart on one side; with arrangements for fixing paper diaphragms so as to isolate certain portions of its interior when experiments with firedamp are undertaken, and so on.

The coal dust is prepared by grinding and screening coal of the following composition:—

	Per cent.
Moisture	1·94
Volatile combustible	35·11
Fixed carbon	57·73
Ash	5·22
	100·00
Sulphur	1·25

The method of conducting the experiments, and the records of their results, are both so similar to those that have been described in two previous reviews,[1] that it would be supererogatory to describe them in this place, more especially as they occupy very little space in the volume before us, and are, as has been said, mostly of a preliminary character.

The remainder of the volume is devoted to a history of the subject, in which our author has done ample justice to the work of his predecessors; to dissertations on "The Humidity of Mine Air," "Remedies for Coal Dust," "Tentative Conclusions on the Dust Problem," and "Special Features in Dust Explosions," written by the author himself, and includes special chapters on "Laboratory Investigations of the Ignition of Coal Dust," by J. C. W. Frazer; "Coal Dust Investigations at European Testing Stations," by Axel Larsen; "Exhaust Steam as a Preventive of Dust Explosions," by Frank Haas; and "Use of Steam and Water Sprays at Oklahoma Mines," by Carl Scholz.

All these subjects have already been investigated and commented upon by other earlier writers, and as there is nothing specially new or original in the articles before us, they need not further detain us in this place. The fact that the "selected bibliography" occupies twelve and a half pages, and that the titles of no fewer than two hundred and four of the papers and articles mentioned in it contain either the word "coaldust," or in some cases simply "dust" and "dusty," as applied to mines, explosions, and experiments, is an indication of the growing interest with which the subject is, and has for some time past been, regarded. Finally, considering the source from which the present report has emanated, it is perhaps almost superfluous to add that it is furnished with a complete index.

The Austrian experiments are being carried out under the auspices of the Vienna Permanent Firedamp Committee, which decided to resume them in 1908 after an interval of several years, during which operations at the experimental gallery at Babitz, near Segengottes, had been suspended. The ostensible object of this new series is "to ascertain the conditions under which coal dust—especially that of the Rossitz district—can be caused to explode even in the absence of firedamp, and to test the means hitherto employed, or proposed, for minimising or preventing coal-dust explosions, chief among them being water curtains, wet and dustless zones, and dry stone-dust zones." "Experiments with coal dust in conjunction with explosive gases are also in contemplation."

The Babitz gallery differs from the others previously referred to, first, in being built partly in masonry and partly in brick work, with an arch of the same materials overhead, and a level floor; and, secondly, in being wholly underground. Its depth under the surface is 2 metres at one end and 21·6 metres at the other. The thickness of cover increases at a fairly uniform rate from the shallower end to a distance of rather more than two-thirds of the whole length, where it attains 7 metres, and thereafter more irregularly to the deeper end. Its length is 293·7 m., and its other dimensions are:—at its deeper end, 1·3 m. wide at the sole, 1·4 m. wide at the spring of the arch, 1·74 m. high, and its sectional area 2·2 square metres; and at its shallower end, 2·4 m. high and 3·4 square metres in sectional area.

[1] NATURE, February 9, 1911, vol. lxxxvi., p. 223.

Travelling communication is established with its interior by means of three shafts, one sloping downwards to a point 1·7 metres distant from its deeper end, provided with stairs and ladders, and with a strong door both at its top and bottom; a second, sloping downwards to a point 82 metres distant from the bottom of the first, also provided with stairs and ladders, and with a strong door at its top and bottom; and a third, at its shallower end, provided with a ladder only, and with its top capable of being closed by means of balks of timber.

The space between the bottom of the deepest shaft and the end of the gallery nearest it (called the explosion chamber) is built of concrete, and is 1·7 m. long, measured in the direction of the axis of the gallery, 1·3 m. wide, and 1·82 m. high. Its open side next the gallery can be closed by means of a paper diaphragm pasted to a wooden frame fixed on the periphery of the gallery, and coal dust and firedamp can be admitted to its interior through two pipes, one for firedamp the other for coal dust, which extend down into it from the surface. At distances of 47·8 and 88·2 metres respectively from the explosion chamber, two other pairs of pipes constitute similar links of communication between the surface and the gallery. One pipe of each pair serves for the introduction of coal dust, the other as an open passage in which a shaft with a circular disc fixed to its lower end, which is in, and just below the roof of, the gallery, can be made to revolve rapidly by means of hand mechanism at the surface. The coal dust, introduced through the two pipes just referred to, falls upon the two corresponding revolving discs, and is disseminated in the surrounding air by the centrifugal force imparted to it by the motion of the discs; that similarly introduced into the explosion chamber passes immediately into the interior of a small vertical fan, made to revolve by means of an electric motor, and is thus disseminated through the air in the chamber in a similar manner.

The gallery is lighted by means of shielded incandescent electric lamps standing in niches in the walls, and is ventilated by means of an electric fan fixed in the shaft farthest from the explosion chamber. The fan is capable of exhausting 20 cubic metres of air per minute from the interior of the gallery.

The coal dust employed in the experiments is collected in the screening sheds (?) and in the workings, and only the most suitable kinds are taken. Amongst these, the finest leaves a residue of 3·8 per cent. on a sieve with 3480 meshes, and the coarsest a residue of 19·5 per cent. on a sieve with 1160 meshes per square centimetre. Its composition is as follows:—

	Per cent.
Moisture	0·58 to 4·5
Volatile matter	19·20 to 22·8
Ash	9·17

When an experiment is about to be made, coal dust is strewn about in the gallery, or placed on a series of seven narrow shelves equally spaced above each other, supported horizontally (and transversely as regards the gallery) in rectangular wooden frames suspended at intervals of 5 m. apart, or laid on slanting laths fastened to the walls, or disseminated in the air by means of the fan in the explosion chamber and the revolving discs previously mentioned, or brought into the sphere of action by any one or any combination of these means.

The explosives employed for disturbing and igniting it are cartridges of gelatine dynamite from 150 up to 300 grams, "for the most part hanging free," and fired electrically with 1-gram caps; or 300 grams of black powder placed loosely in a mortar with a bore of 450 mm. long and 27 mm. in diameter, tamped with paper, and fired with a fuse. In some cases the dynamite charges are fired in the mortar.

No account is given as to the position in which the dynamite cartridges are hung, either as regards their height above the floor or their horizontal distance from the end of the gallery or chamber: nor can we gather where, or at what height, or at what angle from the hori-

zontal, if any, the barrel of the mortar usually stands when a charge is fired from it, or whether there are two mortars, one in the explosion chamber, the other movable to any other desired position. The only reference we can find in this connection is to *a* mortar "on the floor of the gallery," fired in this particular instance at a distance of 20 m. from the explosion chamber (p. 26).

An attempt has been made to measure pressure by means of a spring indicator. We say "attempt," because the curves reproduced on pp. 19 and 22 are of identical construction with, and indistinguishable in this respect from, those obtained by the present writer with a similar contrivance in the small Royal Society gallery (1877–8). We put these curves aside at the time (although we still possess them) as altogether untrustworthy, as we were of opinion that the first impulse given to the piston was due to the initial explosion of firedamp, and its subsequent vibrations to the combined action of the momentum of the moving parts and the resilience of the spring, and not to those of the air in the gallery; and we consider the curves now before us to be of quite as little value as our own.

The length to which the flame extends is ascertained by placing a series of sulphur matches set in wooden blocks at intervals of 1 m. apart along the walls of the gallery, and observing how many of them have been burnt.

A bottle filled with water, suspended neck downwards at a distance of 10 m. from the explosion chamber, with its loosely fitting cork attached by a string to the nearest hanging frame, serves the purpose of collecting a sample of the afterdamp. When the hanging frame moves under the impulse of the blast, the cork is displaced, the water runs out, and the air and gases take its place.

The audible and visible phenomena produced by an explosion are stated to be a shock "followed by a return shock after an interval of not more than two seconds"; the shock expels a column of air from the terminal shaft (the one farthest from the explosion chamber), opens the door at the top of the intermediate shaft (when the door at its bottom, which opens *into* the gallery, has been removed), and expels a cloud of "smoke" (? dust-laden air), followed, when the explosion is violent, by a flame several yards in length; the return shock opens the iron door at the explosion chamber, closes the door at the top of the intermediate shaft, and fresh air rushes in at the shafts at both ends of the gallery. Immediately afterwards, "thick, dense, blackish-grey afterdamp" is expelled from the terminal shaft by the fan. The frames with shelves are usually torn away and shattered; and on one occasion the door at the top of the intermediate shaft, together with portions of its frame, was thrown to a distance of 30 m.

Passing over the accounts of tentative and preliminary experiments, both with suspended cartridges of dynamite and with black powder fired from the mortar, we may take the following as fairly typical examples of the best results with both kinds of explosive:—

(1) With suspended cartridges of dynamite.

With 32·5 k. of dust strewn over a length of 90 m. from the chamber, and with dust being disseminated in the air by the distributing fan in the chamber and by the revolving discs at 47·8 and 82·8 m. from the latter, the length of flame in the gallery was 124 m. and that in the intermediate shaft 24 m.

In another explosion, with a strewing of 90 m., conducted, presumably, under the same conditions as the last, but not so specified, the length of flame was 118 m.; the maximum pressure is stated to have been 1·38 atmosphere, and the duration of the explosion 0·013 second.

(2) With 300 grams of black powder fired in the mortar without tamping, when both discs and the distributing fan were at work, and 30 k. of dust "employed" (some of it probably strewn on the floor?), the length of the flame was 147 m. (p. 25).

With even the finest dust, containing 2·2 to 4·5 per cent. of moisture, only relatively slight explosions and short flames could be obtained with either dynamite or black powder; but with even coarse dust, containing only 0·7 to 1·7 per cent., strewn over a distance of 88·2 m., flames up to 147 m. were produced.

In the second series of experiments, which were made after a new door, that could not be opened by the explosion, had been fixed at the bottom of the intermediate shaft, and a third revolving disc placed at a distance of 120 m. from the chamber, a flame of 200 m. in length was obtained in one of the experiments with a charge of 250 grams of dynamite and with 129 grams of coal dust per cubic metre (containing 13·3 per cent. of ash, 0·45 of moisture, and 19·2 of volatile matter), disseminated over a distance of 120 yards. This coal dust left 12·2 per cent. on a sieve with 3480 meshes per square centimetre.

Under the same conditions, except that the dust contained 7·55 per cent. of moisture, no explosion took place.

Coal dust containing 14 per cent. of ash gave violent explosions with flames 150 m. in length, whereas that containing 47·9 per cent. did not explode.

Coal dust mixed with increasing proportions of Roman cement continued to explode until the mixture contained 63·3 per cent. of the latter. The suggested and highly probable explanation of this apparent anomaly is that the cement dust falls more quickly than the coal dust, and leaves the mixture remaining suspended in the air purer than it would otherwise be.

The influence of wet zones, and what are designated "water curtains," was also investigated. "The wet zones were formed by sprinkling in the usual way just before shot-firing, and were intensified at intervals by water curtains" (p. 34). The "usual way" is probably that described on p. 11, that is, by means of hose pipes attached to branches of a supply pipe laid along the floor of the gallery. The water curtains, which consist in sprays of water issuing upwards, downwards, and across the gallery at right angles to its longer axis from perforations or nozzles in pipes fixed on its periphery, are stated to have produced little effect on the length of the flame (p. 35).

A wet zone of 60 m. extinguishes an explosion even when a dry-dust explosion produced under the same conditions extends to 137 m. in the absence of the water. "With wet zones 36 to 57 m. long, the flame projected beyond them failed to ignite the dust in the immediately adjoining second coal-dust zone in which the third atomiser (revolving disc) was in operation."

In comparing the foregoing results with those obtained in the galleries at Altofts and Liévin, it should be borne in mind that the coal dust employed was collected at the screens and in the workings, that it, consequently, contained indefinite proportions of coarse and fine particles, and that it is lower in volatile matter than the coals employed in the two galleries named.

These less favourable conditions seem to account for its apparently lower inflammability and its greater sensitiveness with regard to increasing proportions of uncombined moisture.

From *a priori* considerations as to the nature of combustion, it might have been thought that the two following propositions could have been accepted as axiomatic, namely, that, *caeteris paribus*, (1) the finer the dust, the greater the proportion of volatile combustible matter, the drier the air and the higher its pressure and temperature, and the less the proportion of mineral matter and moisture (combined and uncombined) the more inflammable the dust; and (2) conversely, with all the conditions reversed. As it is, most of them have been verified by the results of all the recent quantitative experiments, including an excellent series on the laboratory scale by Prof. Bedson and Mr. Widdas.[1]

The results of the experiments made by the Prussian Firedamp Commission[2] seemed to contradict the second condition as to the influence of increase in the proportion of volatile matter, in regard to which they make the following remarks on p. 31:—

(3) "Bei einem Gehalte an flüchtigen Bestandtheilen von 18 bis 22 pCt. scheint die Flammenverlängerung am grössten zu sein" (vi., 4, 9, 10, 11).

(4) "Mit einem höheren Gehalte an flüchtigen Bestandtheilen tritt wieder eine entschiedene Abnahme der Flammenverlängerung ein, selbst bei ganz feinem Staube" (vi., 13, 14, 15, 18, 19, 20, 21, 22). "Es bleiben gleichwohl diese gasreichen Kohlen ohne Ausnahme noch sehr

[1] Transactions of the Institution of Mining Engineers, vol. xxxix. Part V. (1910).

[2] Anlagen zum Haupt-Berichte der Preussischen Schlagwetter-Commission, Band IV. Table VI. Pp. 35 (1886).

gefährlich, wenn dieselben hinreichend feinen Staub liefern; falls dieses aber nicht stattfindet—und dieser Fall scheint in der That recht häufig vorzukommen—bieten dieselben wenig Gefahr" (vi., 23, 24, 25).

"Hiernach haben unsere Versuche die früher verbreiteten Ansichten in diesem Punkte bestimmt widerlegt."

In this case, also, the coal dust was taken from the screens or from the mines, and employed without any previous sifting or preparation of any kind. It was thus of the same character as that employed in the Austrian gallery, and therefore subject to the same drawbacks. In by far the larger number of trials the strewing in the gallery was only 10 m. in length, and the charge of explosive was invariably 230 grams of black powder.

It is therefore undoubtedly useful to have some of the more exact numerical data established by the recent experiments in regard to even a few classes of coal, such as the limit of explosibility with decreasing volatile matter, on the one hand, and with increasing incombustible mineral matter on the other, although it is quite certain that both of these limits must necessarily be profoundly modified by the presence of more or less firedamp in the air, and by the higher temperature, lower capacity for heat, and more active oxidising properties of the oxygen in the air under the compression existing in the condensed wave of an explosion in the workings of a mine.

But it requires very little consideration of the number of natural factors that vary to show that even the most elaborate series of experiments that could possibly be carried out can only touch the outer fringe of the subject.

In these circumstances it is to be hoped that in accepting the loan of the experimental tube and other appliances at Altofts from the colliery owners, and in constituting themselves and others into a committee for the purpose of making experiments with them, the Royal Commission on Mines will confine its attention to a few very definite objects, and will, before everything else, including even the treatment of dust in the main haulage ways, bear in mind that the true solution of the coal-dust question lies in the prevention of explosions by the honest application of well-known means, that is to say, of means applied in such a manner as would, in the opinion of the present writer, who examined the scenes of the explosions in both Whitehaven and Hulton Collieries, undoubtedly have saved the lives of 480[1] men in 1910, and not in the slipshod way in which the law has hitherto allowed.

The siren song of the inventors, vendors, and advocates of rescue appliances which, it is said, have never yet saved a single life after an explosion, but have been the means of losing many; the trumpetings of those who are clamouring for the establishment of "zones," and even the counsels of those who beseech us to have mice and little birds ready to test the afterdamp, seem to have almost completely distracted attention from the real point at issue for several years past. Even the Royal Commission on Mines seems to have allowed itself to become entangled, not only in the Circean alliance referred to above, but to some extent also in a Charybdic whirlpool of supposed palliative suggestions.

As has been often said before, great explosions occur exclusively in dry and dusty mines, and are invariably begun either by the intentional detonation of an explosive (shot-firing) or by the accidental ignition and explosion of a certain volume of inflammable gas. If the coal dust lying within a certain radius of the one presumed centre of disturbance or the other were always rendered sufficiently damp beforehand to prevent it from being raised up into the air by the subsequent blast, a great explosion would be impossible in any mine. One efficient means of attaining this end consists in spraying water from the nozzle of a flexible hose attached to the branch of a water-main or to a tank on wheels containing water and compressed air. The means is, therefore, "not in heaven"—neither is it beyond the sea—"but is very nigh"—is, in fact, already in use in many of our mines.

If the Royal Commission on Mines were only strong enough and independent enough, it would specify categorically *in what manner* (by means of pipes or water-tanks) and *to what extent* (distance or radius, and quantity per unit of area) water must be applied in the case of shot-firing in order to render the operation quite safe, and (shall we also add?) in the presence of accumulations of inflammable gas; it would insist with all the weight of its Royal authority that the regulations which it recommends be placed upon the Statute Book and be rigidly enforced in the practice of every dry and dusty mine working coal with, say, 12 per cent. of volatile matter and upwards, whatever may be the nature of its roof and floor; and it would add in the way of serious and impressive advice to all engaged in mines of this class words of similar import to those employed by the great Hebrew lawgiver in similar circumstances:

"And thou shalt teach them diligently unto thy children,
And shalt talk of them when thou sittest in thine house,
And when thou walkest by the way,
And when thou liest down and when thou risest up.
And thou shalt bind them for a sign upon thine hand,
And they shall be as frontlets between thine eyes,
And thou shalt write them upon thy posts, and on thy gates."

W. GALLOWAY.

[1] Whitehaven Colliery, May 11, 136; Pretoria Pit, Bolton, December 21, 344.

ENTOMOLOGICAL PAPERS.

AMONG a batch of papers received from the Entomological Bureau of the U.S. Department of Agriculture, perhaps the most generally interesting is one, by Mr. F. C. Bishopp, on the distribution of the Rocky Mountain spotted-fever tick (*Dermacentor venustus*). Now that the fever is known to be principally, if not exclusively, transmitted to man by the tick, the determination of the distributional area of the latter has become a matter of importance. Western Montana is the district where the disease occurs in its most virulent form, but it is also met with, although in a less severe type, in parts of Idaho, Wyoming, Utah, and Nevada, and these areas coincide to a great extent with the maximum abundance of the tick, the whole range of which includes parts of Washington, Montana, Oregon, Idaho, Wyoming, Nevada, Utah, Colorado, and a small tract in New Mexico. In its earlier stages the tick infests small mammals, but later on migrates to the larger domesticated species, and it is in districts where the latter abound and brush-wood is plentiful that it attains its maximum development. Unfortunately, the disease appears to be spreading.

In a second pamphlet Mr. T. L. Patterson records the results of investigations into the habits of the larvæ of certain flies of the family Sarcophagidæ in relation to the pernicious gipsy moth (*Porthetria dispar*). As a rule, the sarcophagid maggots feed only on decomposing pupæ of the moth, but consignments from Europe and Japan suggest that the larvæ of some of the flies may be truly parasitic on the pupæ, in which case it is hoped that an additional means of controlling the ravages of the moth may be obtained.

Other pamphlets deal with the "asparagus-miner" (*Agromyza simplex*), insects affecting stored grain, and the one-spray method of checking the codling-moth and the plum-weevil.

According to the report of the Dominion entomologist, Dr. C. G. Hewitt, issued in the annual Report on Experimental Farms for 1909–10, Ottawa, a new Destructive Insect and Pest Bill was introduced during the period under review into the Canadian Parliament. The necessity for such legislation, owing to the rapidly increasing volume of foreign trade, was pressing, as it was essential to provide means against the introduction, or reintroduction, of such pernicious species as the San José scale and woolly aphis, and the brown-tail and gipsy moths. The brown-tail moth, introduced some years ago, is still the most important enemy against which the Entomological Department has to fight, and it is essential that every possible means should be taken to prevent its spread, as otherwise the financial and other losses caused by its devastations will be appalling. It is satisfactory to learn that there were no serious injuries caused during the year by insects harmful to cereal crops, which form the staple of Canadian agriculture.

Interesting observations on the duration of life in *Samia cecropia*, a common American moth, are recorded by Mr.

Philip Rau in vol. xix., No. 2, of the Transactions of the Academy of Science of St. Louis. The cecropia resembles the emperor and lappet moths, which belong to the same family, in taking no nourishment in the adult condition, but whereas the females of the two latter die immediately after oviposition, while the males perish in the act of sexual intercourse, this is not the case with the cecropias, the males living, on an average, a little more than nine days after separating from the females, although the majority of the latter die before all the eggs are deposited. Moreover, unlike those of the European species, the female cecropias do not remain in a torpid condition for days or weeks previous to fertilisation. As the prolongation of the life of the males after sexual intercourse is useless, it cannot be an adaptation for the good of the species, and it is therefore suggested that such longevity may be a survival from a time when it was beneficial.

The inheritance of polymorphism in the American yellow butterfly, *Colias philodice*, is discussed by Prof. J. H. Gerould in the May number of *The American Naturalist*. In this species the female is dimorphic, the ground-colour of the wings being either yellow or white; the yellow phase is in most places the more abundant, although the albinistic phase is dominant in inheritance. Males differ by the narrower black marginal band on the fore-wings, which is usually free from light spots. Since the colour-pattern of the female obtains in those species of the genus where there is no sexual difference in this respect, it is inferred that this represents the primitive type, which seems to survive in the northern *C. nastes*, the ground-colour of which is dull greenish-yellow suffused with brown. In the author's opinion, "the yellow ground-colour and the solid black marginal band [of *philodice*] probably arose by mutation in an undifferentiated *nastes*-like or white stock, and at once became dominant in the male, while the original colours and colour-pattern remained dominant in the female." Passing southwards and westwards, we enter the realm of *C. eurytheme*, a species with an orange ground-colour and very complicated polymorphism, which probably represents the supreme degree of specialisation.

Two species of Thysanura—a Mediterranean bristle-tail (*Thermobia domestica*) and an apparently new spring-tail (*Proisotoma ultonica*)—are added to the fauna of Ireland by Prof. G. H. Carpenter in *The Irish Naturalist* for May. The Rev. F. D. Morice continues his notes on British saw-flies (Tenthredinidæ, &c.) in the May issue of *The Entomologist's Monthly Magazine*.

The division of labour among ants, with special reference to the view that the smaller forms of workers are more active than their larger brethren, is discussed by Miss E. N. Buckingham in vol. xlvi., No. 18, of the Proceedings of the American Academy of Arts and Sciences. As the result of observation, it has been found that in the case of *Camponotus americanus* the males do not perform the chief duties of the nest, but that the queens may take a share of such duties when the colonies are small. The great bulk of the labour is, however, performed by the small and medium-sized workers. In the genus Pheidole, where the intermediate forms have probably been eliminated, all the work is done by small ants. As a general rule, it appears that big ants, like queens, are more active in small than in large colonies. The general inactivity of the big workers and soldiers is an advantage to the colony, as they are not exhausted by labour, and are thus always available for purposes of defence.

Dr. E. Goeldi is communicating a very interesting series of articles on ant-colonies to *Himmel und Erde*. In the May number he illustrates the manner in which the various kinds of ants inhabiting the flooded lands of Amazonia make their nests in trees, so as to be above the water-level, figuring the long, pendant, skein-like nests of *Azteca barbifex*, the torpedo-like structure formed by a species of Camponotus, and the sheet-like *papier-maché* nest of *A. trigona*. Fungus-growing ants are likewise described, with striking illustrations of the crater-like elevations, leading to the subterranean chambers, to be seen in sandy districts of certain parts of America. To these the ants bring fragments of leaves from long distances, and, after storing them in the subterranean chambers, use them as hot-beds for the cultivation of the mycelium stage of the fungus *Rhozites gongulophora*. Whether the fungus, in its fully developed state, ever reaches the surface through one of the entrance-tubes is a moot point.

In No. 1830 of the Proceedings of the U.S. National Museum, Mr. J. C. Crawford continues his descriptions of new Hymenoptera. The types of several of the fifteen species named were forwarded by correspondents of the Bureau of Entomology, and as these species are of interest in connection with economic entomology, the descriptions were published at the earliest possible date.

Attention may be directed to the description by Mr. J. H. Keys in the June number of *The Entomologist's Monthly Magazine* of a new species of British weevil (*Barypithes duplicatus*), on account of the apparent absence of any allusion as to what constitutes the type. It is even left uncertain whether a spot between Broadstairs and Margate, Blean Woods, Kent, or some other place is the type-locality.

R. L.

THE ROTHAMSTED EXPERIMENT STATION.

THE Society for Extending the Rothamsted Experiments met at Harpenden on June 16, and has issued the following report:—

During the past year the work of the Rothamsted Experimental Station has been considerably extended, more particularly in its investigation of the effect upon the fertility of the soil of heating and treatment with antiseptics which destroy the larger organisms there present. A special assistant has been retained to deal with the investigation of greenhouse soils, which, despite their richness in manure, have become "sick" and unable to carry crops. The same factor appears to be concerned in the sickness of the soils of sewage farms, and this question is also under investigation. The examination of the life-history of the larger organisms in the soil has been undertaken in the Rothamsted Laboratory by Mr. T. Goodey, who was appointed for that purpose to a Mackinnon studentship by the Royal Society.

Papers on this question have been published during the year, also on the ammonia content of the atmosphere, on the weeds of arable land in relation to the soils, on the nutrition of plants by non-nitric sources of nitrogen, and on the experimental error attaching to field trials. The Board of Agriculture has also published on behalf of the station an exhaustive report (207 pp. plus 56 maps and figures) on the soils and agriculture of the south-east of England.

Through this additional work the expenditure of the station has exceeded its income by 1000*l*., and a deficit of 1300*l*. has now accumulated.

The Development Commissioners have promised, through the Board of Agriculture, a grant of 2000*l*. for the current year's work, and it is hoped that some such assistance of the kind will be continued in order to provide for the further extension of the work of the station.

To this end it has become necessary (1) to take a lease of the home farm and so secure further land for experiment, (2) to erect additional laboratory accommodation.

It is estimated that 6000*l*. will be required for these purposes, and on the appeal of the society the following subscriptions have already been received or promised:—Duke of Devonshire, P.C., 300*l*.; Lord Iveagh, 200*l*.; Mr. A. Brassey, 100*l*.; Sir J. T. Brunner, Bart, P.C., 300*l*.; Mr. E. H. Carlile, M.P., 52*l*. 10*s*.; Mr. J. F. Mason, M.P., 500*l*.; Mr. R. Mond, 200*l*.; Capt. J. A. Morison, M.P., 500*l*.; Mr. W. Morrison, 100*l*.; Dr. Hugo Muller, F.R.S., 100*l*.; Sulphate of Ammonia Committee, 50*l*.; Sir J. Wernher, Bart., 250*l*.; Mr. J. Martin White, 100*l*.; Sir A. Henderson, Bart., 10*l*. 10*s*. Total, 2763*l*.

At this critical period in the development of agriculture and agricultural science, the Society for Extending the Rothamsted Experiments appeals most earnestly for further assistance to equip Rothamsted—the pioneer among the experimental stations of the world, with a seventy-year history of continuous experiment upon the same land, an institution also which has hitherto been entirely dependent upon private generosity—in a manner adequate to deal with its new responsibilities.

RADIO-TELEGRAPHY.[1]

THE practical application of electric waves to the purposes of wireless telegraphic transmission over long distances has continued to extend to a remarkable degree during the last few years, and many of the difficulties which at the outset appeared almost insurmountable have been gradually overcome—chiefly through the improved knowledge which we have obtained in regard to the subject generally and to the principles involved.

The experiments which I have been fortunate enough to be able to carry out on a much larger scale than can be done in ordinary laboratories have made possible the investigation of phenomena often novel and certainly unexpected.

Although we have—or believe we have—all the data necessary for the satisfactory production and reception of electric waves, we are yet far from possessing any very exact knowledge concerning the conditions governing the transmission of these waves through space, especially over what may be termed long distances. Although it is now perfectly easy to design, construct, and operate stations capable of satisfactory commercial working over distances up to 2500 miles, no really clear explanation has yet been given of many absolutely authenticated facts concerning these waves. Some of these hitherto apparent anomalies I shall mention briefly in passing.

Why is it that when using short waves the distances covered at night are usually enormously greater than those traversed in the daytime, whilst when using much longer

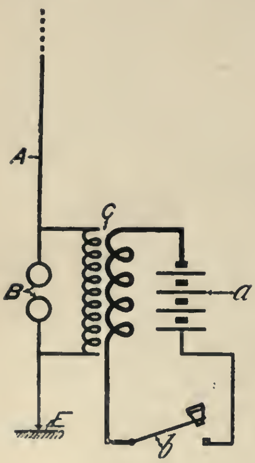


FIG. 1

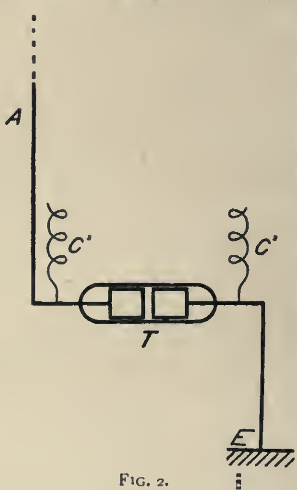


FIG. 2.

waves the range of transmission by day and night is about equal, and sometimes even greater by day?

What explanation has been given of the fact that the night distances obtainable in a north-southerly direction are so much greater than those which can be effected in an east-westerly one?

Why is it that mountains and land generally should greatly obstruct the propagation of short waves when sunlight is present, and not during the hours of darkness?

The general principles on which practical radio-telegraphy is based are now so well known that I need only refer to them in the briefest possible manner.

Wireless telegraphy, which was made possible by the fields of research thrown open by the work of Faraday, Maxwell, and Hertz, is operated by electric waves which are created by alternating currents of very high frequency induced in suitably placed elevated wires or capacity areas. These waves are received or picked up at a distant station on other elevated conductors tuned to the period of the waves, and the latter are revealed to our senses by means of appropriate detectors.

My original system as used in 1896 consisted of the arrangement shown diagrammatically in Fig. 1, where an elevated or vertical wire was employed. This wire sometimes terminated in a capacity, or was connected to earth through a spark gap.

[1] Discourse delivered at the Royal Institution on Friday, June 2, by Commendatore G. Marconi.

By using an induction coil or other source of sufficiently high-tension electricity, sparks were made to jump across the gap; this gave rise to oscillations of high frequency in the elevated conductor and earth, with the result that energy in the form of electric waves was radiated through space.

At the receiving station (Fig. 2) these waves induced oscillatory currents in a conductor containing a detector, in the form of a coherer, which was usually placed between the elevated conductor and earth.

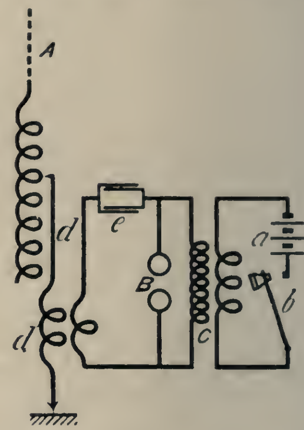


FIG. 3.

Although this arrangement was extraordinarily efficient in regard to the radiation of electrical energy, it had numerous drawbacks.

The electrical capacity of the system was very small, with the result that the small amount of energy in the aërial was thrown into space in an exceedingly short period of time. In other words the energy, instead of giving rise to a train of waves, was all dissipated after only a few oscillations, and, consequently, anything approaching good tuning between the transmitter and receiver was found to be unobtainable in practice.

Many mechanical analogies could be quoted which show that in order to obtain syntony the operating energy must be supplied in the form of a sufficient number of small oscillations or impulses properly timed. Acoustics furnish us with numerous examples of this fact, such as the resonance produced by the well-known tuning-fork experiment.

Other illustrations of this principle may be given, *e.g.* if we have to set a heavy pendulum in motion by means of small thrusts or impulses, the latter must be timed to the period of the pendulum, as otherwise its oscillations would not acquire any appreciable amplitude.

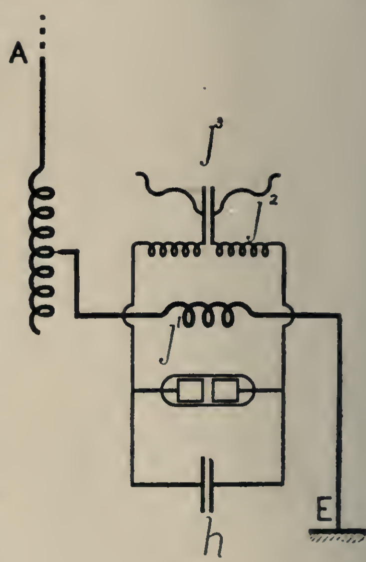


FIG. 4.

In 1900 I first adopted the arrangement which is now in general use, and which consists (as shown in Fig. 3) of the inductive association of the elevated radiating wire with a condenser circuit, which may be used to store up a considerable amount of electrical energy and impart it at a slow rate to the radiating wire.

As is now well known, the oscillations in a condenser circuit can be made to persist for what is, electrically, a long period of time, and it can be arranged, moreover, that by means of suitable aërials or antennæ these oscillations are radiated into space in the form of a series of waves, which through their cumulative effect are eminently suitable for enabling good tuning or syntony to be obtained between the transmitter and receiver.

The circuits, consisting of the condenser circuit and the elevated aërial or radiating circuit, were more or less closely coupled to each other. By adjusting the inductance

in the elevated conductor, and by the employment of the right value of capacity or inductance required in the condenser circuit, the two circuits were brought into electrical resonance, a condition which I first pointed out as being essential in order to obtain efficient radiation and good tuning.

The receiver (as shown in Fig. 4) also consists of an elevated conductor or aërial connected to earth or capacity through an oscillating transformer. The latter also contains the condenser and detector, the circuits being made to have approximately the same electrical time period as that of the transmitter circuits.

At the long-distance station situated at Clifden in Ireland, the arrangement which has given the best results is based substantially upon my syntonic system of 1900, to which have been added numerous improvements.

An important innovation from a practical point of view was the adoption at Clifden and Glace Bay of air condensers composed of insulated metallic plates suspended in air at ordinary pressure. In this manner we greatly reduce the loss of energy which would take place in consequence of dielectric hysteresis were a glass or solid dielectric employed. A very considerable economy in working also results from the absence of dielectric breakages, for, should the potential be so raised as even to produce a discharge from plate to plate across the condenser, this does not permanently affect the value of the dielectric, as air is self-healing, and one of the few commodities which can be replaced at a minimum of cost.

Various arrangements have been tried and tested for obtaining continuous or very prolonged trains of waves, but it has been my experience that, when utilising the best receivers at present available, it is neither economical nor efficient to attempt to make the waves too continuous. Much better results are obtained when groups of waves (Fig. 5) are emitted at regular intervals in such a manner that their cumulative effect produces a clear musical note in the receiver, which is tuned not only to the periodicity of the electric waves transmitted, but also to their group frequency.

In this manner the receiver may be doubly tuned, with the result that a far greater selectivity can be obtained than by the employment of wave-tuning alone.

In fact, it is quite easy to pick up simultaneously different messages transmitted on the same wave-length, but syntonised to different group frequencies.

So far as wave tuning goes, very good results—almost as good as are obtainable by means of continuous oscillations—can be achieved with groups of waves, the decrement of which is in each group 0·03 or 0·04, which means that about thirty or forty useful oscillations are radiated before their amplitude has become too small to affect perceptibly the receiver.

The condenser circuit at Clifden has a decrement of from 0·015 to 0·03 for fairly long waves.

This persistency of the oscillations has been obtained by the employment of the system shown in Fig. 6, which I first described in a patent taken out in September, 1907. This method eliminates almost completely the spark gap and its consequent resistance, which, as is well known, is the principal cause of the damping or decay of the waves in the usual transmitting circuit.

The apparatus shown in Fig. 6 consists of a metal disc *a* having copper studs firmly fixed at regular intervals in its periphery and placed transversely to its plane. This disc is caused to rotate very rapidly between two other discs *b* by means of a rapidly revolving electric motor or steam turbine. These side discs are also made slowly to turn round in a plane at right angles to that of the middle disc. The connections are as illustrated in the figure. The studs are of such length as just to touch the side discs in passing, and thereby bridge the gap between the latter.

With the frequency employed at Clifden, namely, 45,000, when a potential of 15,000 volts is used on the condenser, the spark gap is practically closed during the time in which one complete oscillation only is taking place, when the peripherical speed of the disc is about 600 feet a second. The result is that the primary circuit can continue oscillating without material loss by resistance in the spark gap. Of course, the number of oscillations which can take place is governed by the breadth or thickness of the side discs, the primary circuit being abruptly opened as soon as the studs attached to the middle disc leave the side discs.

The sudden opening of the primary circuit tends to quench immediately any oscillations which may still persist in the condenser circuit; and this fact carries with it a further and not inconsiderable advantage, for, if the coupling of the condenser circuit to the aërial is of suitable value, the energy of the primary will have practically

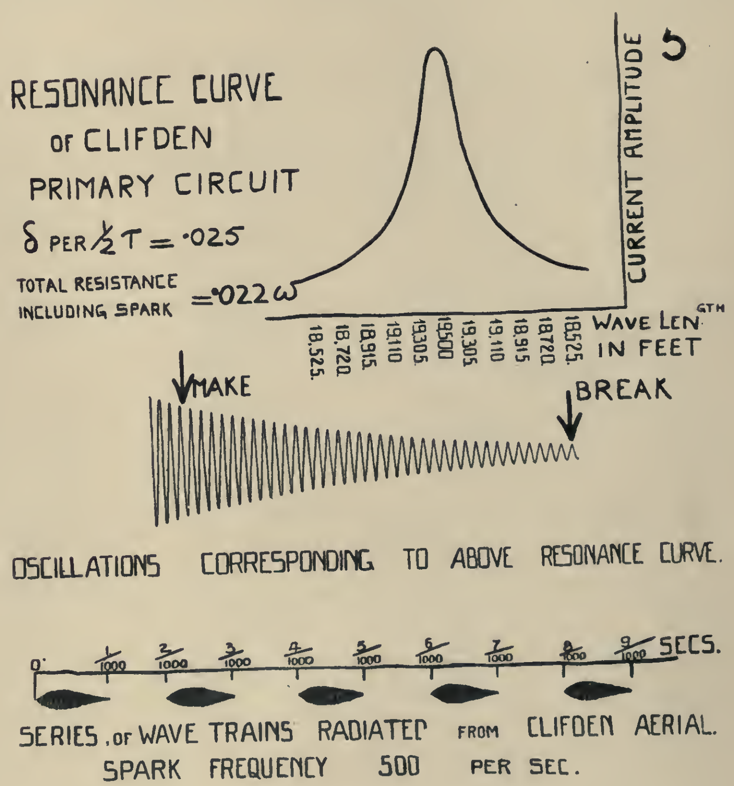


FIG. 5.

all passed to the aërial circuit during the period of time in which the primary condenser circuit is closed by the stud filling the gap between the side discs, but after this the opening of the gap at the discs prevents the energy returning to the condenser circuit from the aërial as would happen were the ordinary spark gap employed. In this manner the usual reaction which would take place between the aërial and the condenser circuit can be obviated, with the result that with this type of discharger and with a suitable degree of coupling the energy is radiated from the aërial in the form of a pure wave, the loss from the spark-gap resistance being reduced to a minimum.

I am able to show a resonance curve taken at Clifden, which was obtained from the oscillations in the primary alone (Fig. 5).

An interesting feature of the Clifden plant, especially from a practical and engineering point of view, is the regular employment of high-tension direct current for charging the condenser. Continuous current at a potential which is capable of being raised to 20,000 volts is obtained

by means of special direct-current generators; these machines charge a storage battery consisting of 6000 cells all connected in series, and it may be pointed out that this battery is the largest of its kind in existence. The capacity of each cell is 40 ampere hours. When employing the cells alone, the working voltage is from 11,000 to 12,000 volts, and when both the direct-current generators and the battery are used together the potential may be raised to 15,000 volts through utilising the gassing voltage of the storage cells.

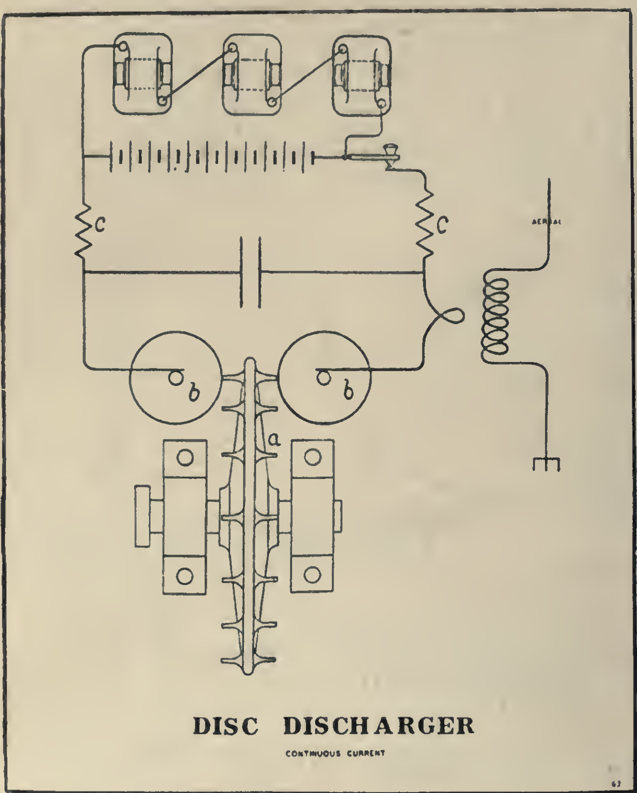


Fig. 6.

For a considerable portion of the day the storage battery alone is employed, with a result that for sixteen hours out of the twenty-four no running machinery need be used for operating the station with the single exception of the small motor revolving the disc.

The potential to which the condenser is charged reaches 18,000 volts when that of the battery or generators is 12,000. This potential is obtained in consequence of the rise of potential at the condenser plates, brought about by the rush of current through the choking or inductance coils at each charge. These coils are placed between the battery or generator and the condenser *c*, Fig. 6.

No practical difficulty has been encountered either at Clifden or Glace Bay in regard to the insulation and maintenance of these high-tension storage batteries. Satisfactory insulation has been obtained by dividing the battery into small sets of cells placed on separate stands. These stands are suspended on insulators attached to girders fixed in the ceiling of the battery-room. A system of switches, which can all be operated electrically and simultaneously, divides the battery into sections, the potential of each section being low enough to enable the cells to be handled without inconvenience or risk.

The arrangement of aërial adopted at Clifden and Glace Bay is shown in Fig. 7. This system, which is based on the result of tests which I first described before the Royal Society in June, 1906,[1] not only makes it possible to radiate efficiently and receive waves of any desired length, but it also tends to confine the main portion of the radiation to any desired direction. The limitation of transmission to one direction is not very sharply defined, but nevertheless the results obtained are exceedingly useful for practical working.

In a similar manner, by means of these horizontal wires, it is possible to define the bearing or direction of a sending station and also limit the receptivity of the receiver to waves arriving from a given direction.

The commercial working of radio-telegraphy and the widespread application of the system on shore and afloat in nearly all parts of the world have greatly facilitated the marshalling of facts and the observation of effects. Many of these, as I have already stated, still await a satisfactory explanation.

A curious result which I first noticed more than nine years ago in long-distance tests carried out on the ss. *Philadelphia*, and which still remains an important feature in long-distance space telegraphy, is the detrimental effect produced by daylight on the propagation of electric waves over great distances.

The generally accepted hypothesis of the cause of this absorption of electric waves in sunlight is founded on the belief that the absorption is due to the ionisation of the gaseous molecules of the air affected by the ultra-violet light, and as the ultra-violet rays which emanate from the sun are largely absorbed in the upper atmosphere of the earth, it is probable that that portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that which is in darkness, and therefore, as Sir J. J. Thomson has shown,[1] this illuminated or ionised air will absorb some of the energy of the electric waves.

The wave-length of the oscillations employed has much to do with this interesting phenomenon, long waves being subject to the effect of daylight to a very much lesser degree than are short waves.

Although certain physicists thought some years ago that the daylight effect should be more marked on long waves than on short, the reverse has been my experience; indeed, in some Transatlantic experiments, in which waves about 8000 metres long were used, the energy received by day at the distant receiving station was usually greater than that obtained at night.

Recent observation, however, reveals the interesting fact that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly and southerly direction being often altogether different from those observed in the easterly and westerly one.

Research in regard to the changes in the strength of the received radiations which are employed for telegraphy across the Atlantic has been recently greatly facilitated by the use of sensitive galvanometers, by means of which the strength of the received signals can be measured with a fair degree of accuracy.

In regard to moderate power stations such as are

Fig. 7.

employed on ships, and which, in compliance with the International Convention, use wave-lengths of 300 and 600 metres, the distance over which communication can be effected during daytime is generally about the same, whatever the bearing of the ships to each other or to the land stations, whilst at night interesting and apparently curious results are obtained. Ships more than 1000 miles away, off the south of Spain or round the coast of Italy,

[1] "On Methods whereby the Radiation of Electric Waves may be mainly confined," &c. Proceedings of the Royal Society, A. vol. lxxvii., 1906.

[1] See *Philosophical Magazine*, August, 1902, ser. 6, vol. iv., p. 253, J. J. Thomson, "On some Consequences," &c.

can almost always communicate during the hours of darkness with the Post Office stations situated on the coasts of England and Ireland, whilst the same ships when at a similar distance on the Atlantic to the westward of these islands, and on the usual track between England and America, can hardly ever communicate with these shore stations unless by means of specially powerful instruments.

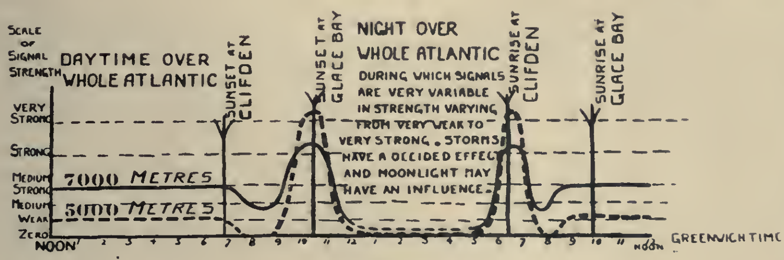


FIG. 8.

It is also to be noticed that in order to reach ships in the Mediterranean the electric waves have to pass over a large portion of Europe and, in many cases, over the Alps. Such long stretches of land, especially when including very high mountains, constitute, as is well known, an insurmountable barrier to the propagation of short waves during daytime. Although no such obstacles lie between the English and Irish stations and ships in the North Atlantic *en route* for North America, a night transmission of 1000 miles is there of exceptionally rare occurrence. The same effects generally are noticeable when ships are communicating with stations situated on the Atlantic coast of America.

Although high-power stations are now used for communicating across the Atlantic Ocean, and messages can be sent by day as well as by night, there still exist periods of fairly regular daily occurrence during which the strength of the received signals is at a minimum. Thus in the morning and the evening, when, in consequence of the difference in longitude, daylight or darkness extends only part of the way across the ocean, the received signals are at their weakest. It would almost appear as if electric waves in passing from dark space to illuminated space, and *vice versa*, were reflected and refracted in such manner as to be diverted from the normal path.

Later results, however, seem to indicate that it is unlikely that this difficulty would be experienced in telegraphing over equal distances north and south on about the same meridian, as, in this case, the passage from daylight to darkness would occur more rapidly over the whole distance between the two stations.

I have here some diagrams which have been carefully prepared by Mr. H. J. Round. These show the average daily variation of the signals received at Clifden from Glace Bay.

The curves traced on diagram No. 8 show the usual variation in the strength of these Transatlantic signals on two wave-lengths, one of 7000 metres and the other of 5000 metres.

The strength of the received waves remains, as a rule, steady during daytime.

Shortly after sunset at Clifden they become gradually weaker, and about two hours later they are at their weakest. They then begin to strengthen again, and reach a very high maximum at about the time of sunset at Glace Bay.

They then gradually return to about normal strength, but through the night they are very variable. Shortly before sunrise at Clifden the signals commence to strengthen steadily, and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases again until it reaches a very marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

It can be noticed that, although the shorter wave gives on the average weaker signals, its maximum and minimum variations of strength very sensibly exceed that of the longer wave.

Diagram 9 shows the variations at Clifden during periods of twenty-four hours, commencing at 12 noon, throughout the month of April, 1911, the vertical dotted lines representing sunset and sunrise at Glace Bay and Clifden.

Diagram 10 shows the curve for the first day of each month for one year from May, 1910, to April, 1911.

I carried out a series of tests over longer distances than had ever been previously attempted in September and October of last year between the stations at Clifden and Glace Bay, and a receiving station placed on the Italian ss. *Principessa Mafalda*, in the course of a voyage from Italy to the Argentine (Fig. 11).

During these tests the receiving wire was supported by means of a kite, as was done in my early Transatlantic tests of 1901, the height of the kite varying from about 1000 to 3000 feet. Signals and messages were obtained without difficulty by day as well as by night up to a distance of 4000 statute miles from Clifden.

Beyond that distance reception could only be carried out during night time. At Buenos Aires, more than 6000 miles from Clifden, the night signals from both Clifden

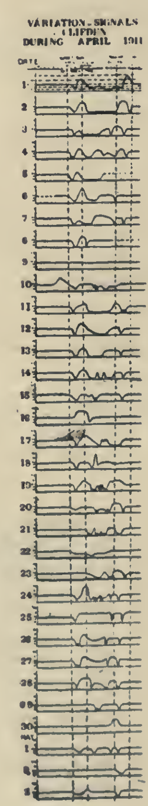


FIG. 9.

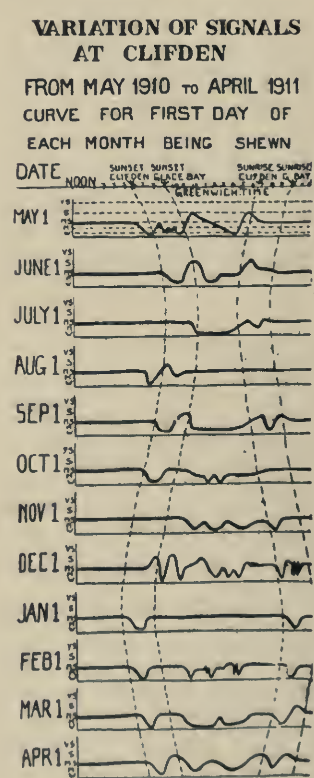


FIG. 10.

and Glace Bay were generally good, but their strength suffered some variations.

It is rather remarkable that the radiations from Clifden should have been detected at Buenos Aires so clearly at night time and not at all during the day, whilst in Canada the signals coming from Clifden (2400 miles distant) are no stronger during the night than they are by day.

Further tests have been carried out recently for the

Italian Government between a station situated at Massaua in East Africa and Coltano in Italy. Considerable interest attached to these experiments in view of the fact that the line connecting the two stations passes over exceedingly dry country and across vast stretches of desert, including parts of Abyssinia, the Sudan, and the Libyan Desert. The distance between the two stations is about 2600 miles.

FIG. 11.

The wave-length of the sending station in Africa was too small to allow of transmission being effected during daytime, but the results obtained during the hours of darkness were exceedingly good, the received signals being quite steady and readable.

The improvements introduced at Clifden and Glace Bay have had the result of greatly minimising the interference to which wireless transmission over long distances was particularly exposed in the early days.

The signals arriving at Clifden from Canada are, as a rule, easily read through any ordinary electrical atmospheric disturbance. This strengthening of the received signals has, moreover, made possible the use of recording instruments which not only give a fixed record of the received messages, but are also capable of being operated at a much higher rate of speed than could ever be obtained by means of an operator reading by sound or sight. The record of the signals is obtained by means of photography in the following manner. A sensitive Einthoven string galvanometer is connected to the magnetic detector or valve receiver, and the deflections of its filament caused by the incoming signals are projected and photographically fixed on a sensitive strip, which is moved along at a suitable speed (Fig. 12). On some of these records, which I am able to show, it is interesting to note the characteristic marks and signs produced amongst the signals by natural electric waves or other electrical disturbances of the atmosphere, which, on account of their doubtful origin, have been called "X's."

Although the mathematical theory of electric wave propagation through space was worked out by Clerk Maxwell more than fifty years ago, and notwithstanding all the experimental evidence obtained in laboratories concerning the nature of these waves, yet, so far, we understand but incompletely the true fundamental principles concerning the manner of propagation of the waves on which wireless telegraph transmission is based. For example, in the early days of wireless telegraphy it was generally believed that the curvature of the earth would constitute an insurmountable obstacle to the transmission of electric waves between widely separated points. For a considerable time not sufficient account was taken of the probable effect of the earth connection, especially in regard to the transmission of oscillations over long distances.

Physicists seemed to consider for a long time that wireless telegraphy was solely dependent on the effects of free Hertzian radiation through space, and it was years before the probable effect of the conductivity of the earth was considered and discussed.

Lord Rayleigh, in referring to Transatlantic radiotelegraphy, stated in a paper read before the Royal Society in May, 1903, that the results which I had obtained in signalling across the Atlantic suggested "a more decided bending or diffraction of the waves round the protuberant earth than had been expected," and, further, said that it imparted a great interest to the theoretical problem.[1] Prof. Fleming in his book on electric-wave telegraphy gives diagrams showing what may be taken to be a diagrammatic representation of the detachment of semi-loops of electric strain from a simple vertical wire (Fig. 13).

As will be seen, these waves do not propagate in the same manner as does free radiation from a classical Hertzian oscillator, but instead glide along the surface of the earth.

Prof. Zenneck[2] has carefully examined the effect of earthed receiving and transmitting aërials, and has endeavoured to show mathematically that when the lines of electrical force, constituting a wave front, pass along a surface of low specific inductive capacity—such as the earth—they become inclined forward, their lower ends being retarded by the resistance of the conductor to which they are attached. It therefore would seem that wireless telegraphy as at present practised is, to some extent at least, dependent on the conductivity of the earth, and that the difference in operation across long distances of sea compared to over land is sufficiently explained by the fact that sea water is a much better conductor than is land.

The importance or utility of the earth connection has been sometimes questioned, but in my opinion no practical

FIG. 12.

system of wireless telegraphy exists where the instruments are not in some manner connected to earth. By connection to earth I do not necessarily mean an ordinary

[1] Proceedings of the Royal Society, vol. lxxi., May 28, 1903.
[2] See J. Zenneck. *Annalen der Physik*, 23. 5. p. 846, September, 1908. *Physikal Zeitschrift*, No. 2, p. 50; No. 17, p. 553.

metallic connection as used for wire telegraphs. The earth wire may have a condenser in series with it, or it may be connected to what is really equivalent, a capacity area placed close to the surface of the ground. It is now perfectly well known that a condenser, if large enough, does not prevent the passage of high-frequency oscillations, and therefore in this case, when a so-called balancing capacity is used, the antenna is for all practical purposes connected to earth.

I am also of opinion that there is absolutely no foundation in the statement, which has recently been repeated, to the effect that an earth connection is detrimental to good tuning, provided, of course, that the earth is good.

Certainly, in consequence of its resistance, what electricians call a bad earth will damp out the oscillations, and in that way make tuning difficult; but no such effect is noticed when employing an efficient earth connection.

In conclusion, I believe that I am not any too bold when I say that wireless telegraphy is tending to revolutionise our means of communication from place to place on the earth's surface. For example, commercial messages containing a total of 812,200 words were sent and received between Clifden and Glace Bay from May 1, 1910, to the end of April, 1911; wireless telegraphy has already furnished means of communication between ships and the shore where communication was before practically impossible. The fact that a system of imperial wireless telegraphy is to be discussed by the Imperial Conference now holding its meetings in London shows the supremely important position which radio-telegraphy over long distances has assumed in the short space of one decade. Its importance from a commercial, naval, and military point of view has increased very greatly during the last few years as a consequence of the innumerable stations which have been erected or are now in course of construction on various coasts, in inland regions, and on board ships in all parts of the world. Notwithstanding this multiplicity of stations and their almost constant operation, I can say from practical experience that mutual interference between properly equipped and efficiently tuned instruments has so far been almost entirely absent. Some interference does without doubt take place between ships in consequence of the fact that the two wave-lengths adopted in accordance with the rules laid down by the International Convention are not sufficient for the proper handling of the very large amount of messages transmitted from the ever-increasing number of ships fitted with wireless telegraphy. A considerable advantage will be obtained by the utilisation of a third and longer wave to be employed exclusively for communication over long distances.

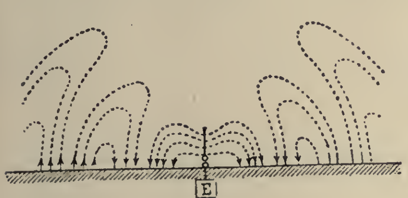


FIG. 13.

In regard to the high-power Transatlantic stations, the facility with which interference has been prevented has to some extent exceeded my expectations. At a receiving station situated at a distance of only eight miles from the powerful sender at Clifden, during a recent demonstration arranged for the Admiralty, messages could be received from Glace Bay without any interference from Clifden when this latter station was transmitting at full power on a wave-length differing only 25 per cent. from the wave radiated from Glace Bay, the ratio between the maximum recorded range of Clifden and 8 miles being in the proportion of 750 to 1.

Arrangements are being made permanently to send and receive simultaneously at these stations, which, when completed, will constitute in effect the duplexing of radio-telegraphic communication between Ireland and Canada.

The result which I have last referred to also goes to show that it would be practicable to operate at one time on slightly different wave-lengths a great number of long-distance stations situated in England and Ireland without danger of mutual interference.

The extended use of wireless telegraphy is principally dependent on the ease with which a number of stations can be efficiently worked in the vicinity of each other.

Considering that the wave-lengths at present in use range from 200 to 23,000 feet, and, moreover, that wave-group tuning and directive systems are now available, it is not difficult to foresee that this comparatively new method of communication is destined to fill a position of the greatest importance in facilitating communication throughout the world.

Apart from long-distance work, the practical value of wireless telegraphy may perhaps be divided into two parts, (1) when used for transmission over sea, (2) when used over land.

Many countries, including Italy, Canada, and Spain, have already supplemented their ordinary telegraph systems by wireless telegraphy installations, but some time must pass before this method of communication will be very largely used for inland purposes in Europe generally, owing to the efficient network of landlines already existing, which render further means of communication unnecessary; and therefore it is probable that, at any rate for the present, the main use of radio-telegraphy will be confined to extra-European countries, in some of which climatic conditions and other causes absolutely prohibit the efficient maintenance of landline telegraphy. A proof of this has been afforded by the success which has attended the working of the stations recently erected in Brazil on the Upper Amazon.

By the majority of people the most marvellous side of wireless telegraphy is perhaps considered to be its use at sea. Up to the time of its introduction, ships at any appreciable distance from land had no means of getting in touch with the shore throughout the whole duration of their voyage. But those who now make long sea journeys are no longer cut off from the rest of the world; business men can continue to correspond at reasonable rates with their offices in America or Europe; ordinary social messages can be exchanged between passengers and their friends on shore; a daily newspaper is published on board most of the principal liners giving the chief news of the day. Wireless telegraphy has on more than one occasion proved an invaluable aid to the course of justice, a well-known instance of which is the arrest which took place recently through its agency of a notorious criminal when about to land in Canada.

The chief benefit, however, of radio-telegraphy lies in the facility which it affords to ships in distress of communicating their plight to neighbouring vessels or coast stations; that it is now considered indispensable for this reason is shown by the fact that several Governments have passed a law making a wireless telegraph installation a compulsory part of the equipment of all passenger boats entering their ports.

THE PROPOSED TEACHERS' REGISTRATION COUNCIL.

IT would seem from the recently published Parliamentary Paper (Cd. 5726), entitled "Further Papers relating to the Registration of Teachers and the proposed Registration Council," that the formation of the much desired Teachers' Council, with which will rest the responsibility of preparing a Register of Teachers, will not be long delayed.

The papers include a summary of proceedings at the conference of November, 1909, convened by the Federal Council of Secondary School Associations in conjunction with other important educational associations; the alternative proposals discussed in Parliament in 1906, and other minutes and important data concerning the formation of such a council of teachers. The most important section, however, is that containing a report by Sir Robert Morant, secretary to the Board of Education, upon three informal conferences held recently at the Board of Education to discuss the whole matter, together with the outline of a scheme for the formation of a Teachers' Council.

This scheme lays great emphasis upon the question of the unification of the teaching profession, and makes provision for full representation upon the council of the universities of England and Wales. On this point Sir Robert Morant says:—

"From the point of view of a council which is to be, above all things, representative of the whole teaching profession, it is obvious that there must be a university group just as much as an elementary group and a secondary group. To speak of a professional council of the teaching profession without a full inclusion of the universities would obviously be absurd."

"Now the number of universities in England and Wales is eleven, and it is obvious that it would be quite impossible for these eleven universities to combine as an electoral college to name (say) five or six individuals to represent them, collectively, on such a council as is here in question, and the only conceivable method of meeting the case is that each of the eleven should have one representative.

"If, then, this group is to be composed of eleven members, this must be equally so in regard to the other three groups, according to the principle already proposed and accepted. . . . The council would thus be composed of four groups, each having eleven members."

The four groups which are each to be represented by eleven members are the university, elementary, secondary, and technological and specialist. In defining the last-named group, Sir Robert Morant remarks:—

"From some of the difficulties that have specially arisen in respect of that part of the scheme, it would seem that its nomenclature is, in some senses, inappropriate, and that what is really in question, on this side, is the need of representation of what may be called 'specialist teachers' (as well as technological teachers), as contrasted with what are usually regarded as teachers in the field of general education, or as 'general practitioners,' as was suggested at my second conference."

"It would therefore seem essential that the Teachers' Council, to be really representative of the whole profession, must comprise a representation of university teachers just as much as of elementary teachers, of secondary teachers, and of technological and specialist teachers; a council composed of these four elements would, in fact, be *representative of the whole teaching profession*, which otherwise would not be the case."

Again to quote the secretary of the Board of Education:—

"It will probably, however, be the case, from the very fact that the council will comprise representatives of widely different points of view as belonging to widely different branches of the profession, that its deliberations will best be managed under the chairmanship of someone not identified with any one of the several branches or sections; and from this point of view it would probably be desirable that the Order in Council should provide one vacancy for a chairman, to be chosen by the council from outside their numbers, who would doubtless be a man of distinction and possessing the characteristics requisite in an effective president of a body of this kind, whose deliberations would constantly be upon matters in which divergent interests and opposing points of view would frequently occur."

"This would bring the total number of the council to forty-five—a large body, but by no means too large to represent adequately the whole of so vast and important a profession as the teaching profession, nor, on the other hand, too large for arriving at effective decisions on the points likely to come before it, seeing that many of the more technical points would first have been thrashed out in special committees, and in meetings of one or more special committees meeting together, before coming before the council to be decided finally."

Mr. Runciman appends a note to the report signifying his agreement, and requesting Sir Robert Morant to have a draft made, as soon as possible, of an Order in Council on the lines outlined above.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Harkness scholarship for 1911 has been awarded to Mr. T. C. Nicholas and Mr. J. Romanes. The Frank Smart prizes have been awarded to Mr. S. R. Price (botany) and Mr. S. T. Burfield (zoology).

Mr. C. T. R. Wilson has been reappointed demonstrator of experimental physics for a period of five years from Michaelmas, 1911.

Mr. F. T. Brooks has been appointed senior demonstrator of botany, and Mr. D. Thoday junior demonstrator of botany, both for two years ending September 30, 1913.

We learn from *The Times* that Mr. Robert Christison, of Burwell Park, Lincolnshire, and late of Lammermoor, Queensland, has telegraphed to Sir William MacGregor, the Governor of the State of Queensland and Chancellor of the University of Brisbane, his willingness to contribute a further 1000*l*. (having already given 1000*l*.) for the foundation of a chair for tropical and sub-tropical agriculture.

It is announced in *Science* that Mr. Morton P. Plant has offered to give an endowment of 200,000*l*. for the woman's college which is to be established at New London, Conn.; it is a condition that the name shall be changed to the Connecticut College for Women. From the same source we learn that the General Educational Board has made public a list of its latest grants for colleges and schools, amounting in all to 126,800*l*. All the gifts to colleges are conditional and are applied to endowment only. Other gifts may be applied to current expenses. The grants include:—

College	Appropriation £	To be raised £
Converse, Spartansburg, S.C.	10,000	20,000
Drury, Springfield, Mo.	15,000	65,000
Franklin, Franklin, Ind.	15,000	65,000
Franklin and Marshall, Lancaster, Pa.	10,000	45,000
Huron, Huron, S.D.	20,000	20,000
Pennsylvania, Gettysburg, Pa.	10,000	30,000
Totals	80,000	245,000

Science also states that Brown University receives a bequest of 17,000*l*. from Dr. Oliver H. Arnold, of Providence.

SOCIETIES AND ACADEMIES.

London.

Royal Society June 15.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. T. G. **Brodie**: Croonian lecture: A new conception of the glomerular activity. All the more recent work upon the kidney has proved conclusively that Ludwig's explanation of the glomerular function, viz. that the glomerulus is a filtering mechanism, is incorrect. The structural details of this highly characteristic portion of the renal apparatus strongly suggest that in some way or other the blood pressure is made use of in the work of the glomerulus. Having excluded filtration in this connection, there is yet another way in which it could be directly utilised, viz. in setting up a pressure-head by means of which the watery part of the urine could be driven through the very long and narrow tubule. In reference to this side of its activity, it is suggested that the glomerulus be termed a "propulsor." An approximate calculation of the pressure-head necessary to drive the fluid along the tubule during the height of activity proves that one about equal to that present within the glomerular capillaries is required. Evidence of the action of a high intra-tubular pressure is at once obtainable from the microscopic examination of a kidney after activity. The capsules of Bowman are greatly distended and approximately spherical in shape, the glomeruli are moderately enlarged and no longer fill the capsular spaces. The tubules are straightened out, stretched, and possess a conspicuous lumen. All these changes are exaggerated by any procedure which favours the action of this intra-tubular pressure, such as a high arterial blood pressure, obstruction to the outflow of urine from the ureter, or the stripping of the capsule from the kidney. Further, the kidney during activity is tense and hard, and distends its capsule to the utmost. This conception of the glomerular function affords a complete explanation of the existence of a firm and inextensible capsule surrounding the kidney, as also of such phenomena as the maximum ureter pressure, the dependence of the rate of discharge of urine from the kidney upon the general blood pressure, and the degree of dilatation of the renal arterioles, &c. Applying

this theory to the study of the action of diuretics in animals in which the blood pressure has been lowered so far that propulsion can no longer occur, we obtain evidence as to the parts of the renal tubules acted upon by these different substances.—A. R. **Cushny**: The action of Senecio alkaloids and the causation of hepatic cirrhosis in cattle. Various species of Senecio (ragwort) have been shown to induce fatal poisoning in cattle and horses in South Africa, Canada, and New Zealand. The alkaloids of one of these species were isolated by Watt, and their pharmacological examination shows that they induce the same symptoms as the entire plant. The Senecio species in this country proved non-toxic, except the common groundsel (*S. vulgaris*), and extracts from the ragwort grown in Canada, where the plant is poisonous, proved devoid of action also. This may, however, be due to the season at which the plant was gathered.—G. **Buchanan**: Note on developmental forms of *T. brucei* (*pecaudi*) in the internal organs, axillary glands, and bone-marrow of the gerbil.—Captain W. B. **Fry**: A preliminary note on the extrusion of granules by trypanosomes.

Physical Society, June 9.—Prof. H. L. Callendar, F.R.S., in the chair.—W. **Mason**: The Lüders' lines on mild steel. Previous investigations have shown that Lüders' lines on specimens of mild steel and wrought iron, strained in tension, are inclined at about 50° to the axis of pull. For tests in compression the information available is not precise, and though the angle of the lines with the direction of the compression is commonly understood to be about 40°, some doubt has been thrown on this point. The author had found previously that the lines are well developed on the surface of mild steel tubes. Since it was easy to obtain a compressive stress of practically uniform distribution in tubes under end pressure, while at the same time a hoop tensile stress could be induced by internal fluid pressure, the author confined his attention to the lines on tubular specimens. These were of mild steel, either hot or cold drawn, and most of them were annealed. The Lüders' lines on the outer surface appeared at the yield point indicated by the extensometer, *i.e.* their appearance coincided with the commencement of the large "yield" strain. In all cases where there were lines on the inner and outer surfaces of a tube, an inner and outer line, and also the ends of these lines, were found to be radially opposite, showing that the lines were traces of surfaces or canals of disturbance which passed through the tube wall, and indicating, moreover, that the disturbance spread spirally onwards, and not outwardly from a line initially formed on the more severely stressed inner surface. The conclusion is drawn that the Lüders' surfaces have the same, or approximately the same, inclination to an axis of simple pull or simple push. With stresses of opposite sign at right angles to each other, the lines and surfaces are more inclined to the stress of greater intensity, and with equal intensities the surfaces are at about 45°.—Prof. S. P. **Thompson**: A new method of harmonic analysis by averaging selected ordinates. Assume with Fourier that the curve representing any periodic single-valued function of x may be expressed by the harmonic series

$$y = A_1 \sin x + A_2 \sin 2x + A_3 \sin 3x + \ldots\ldots + B_1 \cos x + B_2 \cos 2x + B_3 \cos 3x.$$

Then to find the coefficient of any term, A_n or B_n, it suffices—subject to a limitation stated below—to measure off on the curve $2n$ equidistant ordinates over one period, that is, spaced at successive intervals apart of π/n. Then, having reversed the sign of every alternate ordinate, the simple algebraic mean of them gives the coefficient sought. For cosine-coefficients the first ordinate must be taken at the origin, while for sine-coefficients the first ordinate must be taken at a point $\frac{1}{2}\pi/n$ from the origin. The process is much facilitated by the use of templates of transparent celluloid having equispaced vertical lines engraved upon them. They are laid down on the curve, and the values of the selected ordinates are thus readily measured off. For analysis of valve-motions, of alternating-current curves, of tidal observations, and diurnal magnetic variations, the method presents certain advantages, as it requires no multiplication of ordinates by sines or cosines.—Prof. S. P. **Thompson**: Demonstration of the subjective nature of the difference tone. Two tuning-forks of frequencies 3328 and 3584 were sounded loudly. On striking the second the difference tone was heard, but while the notes from the two forks seemed to come in a definite direction from an external source, the difference tone seemed to be located in the ear itself.—Sir George **Greenhill**: Spinning tops and gyroscopic apparatus. A 52-inch Otto bicycle wheel was shown mounted on an axle with ball bearings, and spun by hand with the point in a small cup, to serve as a spinning top visible to a large audience. The gyroscopic apparatus was made of an ordinary 28-inch bicycle wheel, the axle screwed into a stalk of a short length of rifle barrel, suspended from a lug on a bicycle hub; the hub is fastened to an iron bracket, which is bolted to the under side of a beam or sleeper, large enough to absorb vibration, and resting on two step ladders. The wheel is spun by hand, and the axle is projected to obtain any desired gyroscopic motion, undulating, looped, or with cusps. The wheel can be detached by unscrewing the pin through the lug, and can then be used like the large wheel as a spinning top, or as the "Top on the top of a Top" described in Maxwell's "Life." Put the wheel out of balance by a bar through the spoke and hold the axle, and it will serve as a pendulum, making oscillations however large, or complete revolutions, and the effect may be investigated of varying the angle of the axle with the vertical.—Prof. H. N. **Allen**: A model illustrating the passage of a light wave through quartz. If a crystal is so cut, and a wave sent through it in such a way as to avoid separation of the two component waves by double refraction, it is easy to construct models showing how a vibration gradually alters in form as it passes through the crystal. The model exhibited illustrates the passage of a wave originally plane polarised through a crystal which rotates the plane of polarisation of light sent along its axis (quartz).—Prof. A. **Anderson** and J. E. **Bowen**: The measurement of contact differences of potential. The paper describes two methods of measuring the contact differences of potential of pairs of metals. The first, or deflection, method depends on the property which a radio-active source has of destroying a field of electrostatic force in air, and the second, or null, method on the possibility of determining by means of such a source whether such a field exists between two plates at zero potential. Measurements were made on ten different metals, and it was found that both methods gave practically the same results provided that the time which was allowed to elapse between the two measurements was sufficiently small. The addition law was verified.—A. **Johnstone**: A short table of circular and hyperbolic functions for complex values of the argument.

Zoological Society, June 13.—Mr E. T. Newton, F.R.S., in the chair.—H. G. **Plimmer**: Report on the pathological examination of rats caught in the Regent's Park and in the society's gardens. Five hundred rats had been examined between January 1 and May 17, all in a precisely similar manner. The spleen, lungs, glands, and blood were examined microscopically, and from any animal which looked in any way unhealthy cultures were made. The results were summarised as follows:—5 rats were caught in the park, and 495 in the gardens; 283 of these were males and 217 females. Three rats had tubercle, 10 had tapeworm cysts in the liver, 49 had *Trypanosoma lewisi* in their blood, 2 had empyema (not tubercular), 1 had a tumour of the lower jaw (the result of an old injury), and 1 had pleuritis and hydrothorax (not tubercular). Bacteria were found in 71 rats: in 40 in the lungs and in 31 in the spleen. Saccharomycetes were found in the lungs of 16 rats. Fleas were found on 4 rats, and lice on 3 rats. The general condition of the rats was very good, and in none was anything at all suspicious found.—Dr. R. E. **Drake-Brockman**: Antelopes of the genera Madoqua and Rhynchotragus found in Somaliland. The author made general remarks on all the dik-diks, and gave a short account of the species and subspecies, including the description of a new form.—Hon. Paul A. **Methuen**: An amphipod from the Transvaal. A detailed description of a new fresh-water gammarid of the genus Eucrangonyx found in caves in the Transvaal.—R. **Lydekker**: Three African animals. The first specimen was the skull of a

Somali rhinoceros, a race for which the author adopted the name *Rhinoceros bicornis somalicus*, Potocki. A klipspringer skull from northern Nigeria, characterised by its great width and the peculiar form of the lacrymal bone, was described as the type of a new race, *Oreotragus saltator porteusi*. Finally, a gazelle from Algeria was referred to a new species, *Gazella hayi*, agreeing approximately in size with *G. dorcas*, but distinguished by the much straighter and non-lyrate horns, each of which carried only about a dozen rings. The face-markings were approximate to those of *G. cuvieri*.—C. E. **Hellmayr**: A contribution to the ornithology of western Colombia. This memoir was based on a collection made by Mr. M. G. Palmer in 1908 and 1909, which, though numbering hardly 700 specimens, was of considerable interest and contained many rare species, and also furnished information of importance to students of zoogeographical problems.—Angel **Cabrera**: Subspecies of the Spanish ibex. The author dealt with the geographical distribution of, and the differences between, the various races, and described a new subspecies from the Sierra de Gredos, the type-specimen of which was in the Madrid Museum.

Linnean Society, June 15.—Dr. A. B. Rendle, F.R.S., vice-president, in the chair.—Miss H. M. **Cunnington**: The anatomy of *Enhalus acoroides*, Rich.—Prof. **Imms**: The life-history of *Croce filiformis*, Westw.—Papers on insect collections from the islands of the Indian Ocean, communicated by Prof. J. Stanley Gardiner. Eight papers were brought forward, four dealing with various groups of Hymenoptera, one with Lepidoptera, and three with Diptera. The first was by Prof. J. J. **Kieffer**, on parasitic Hymenoptera of the family Cynipidæ, or gall-wasps. This family appears to be poorly represented in the Seychelles; only eight species (all new) were found, none belonging to the gall-forming section of the family, but all to the zoophagous sections; their size as compared with that of many zoophagous Cynipidæ in other parts of the world is very small. The second paper was by the same author, dealing with the group of small and minute parasitic Hymenoptera known as Proctotrupoidea. A rich material of these was obtained, representing seven of the families into which the super-family Proctotrupoidea is divided, and consisting of sixty-six species, all new to science. These insects are very incompletely known, and several of the genera enumerated in the paper are also new. The third paper was on the bees obtained by the expedition to the Seychelles and Aldabra in 1908–9, by Prof. T. D. A. **Cockerell**, of the University of Colorado. It adds considerably to the previously known bee fauna of these islands, fifteen species being enumerated, eight of which are new to science. The author shows that the bees of the Seychelles consist of (i) an endemic element, composed partly of species without close allies elsewhere, and partly of species closely allied to forms found in other parts of the world, and (ii) certain widely spread species, perhaps introduced by man. The Aldabra bee fauna also contains an endemic element, as well as a single Madagascar species. This paper was followed by that of Mr. G. **Meade-Waldo** on the wasps (Diploptera) obtained by the expedition; it enumerates five kinds, but adds no species to the previous lists. Mr. J. C. F. **Fryer's** paper deals with all the Lepidoptera obtained by the expedition of 1908–9, excepting the plume-moths and the Tortrices and Tineina, which were worked out some time ago by Mr. Bainbrigge Fletcher and Mr. Meyrick respectively. Almost all the material from Aldabra, and some of that from the Seychelles, was collected by the author himself. The total number of Lepidoptera known from the Seychelles (including those dealt with previously by Mr. Fletcher and Mr. Meyrick) is now 240, of which more than 120 are peculiar to the islands. Mr. Fryer's own paper deals with 123 species, of which thirty are new. He states that these thirty are for the most part very distinct and well separated from their allies, while the non-peculiar species are mostly widely distributed, with a slight preponderance of African forms. With regard to Aldabra, sixty-six species are known from there, seven being, so far as is known, peculiar, while the rest all belong to African or Madagascar forms. The next two papers were by Mr. J. E. **Collin**, on two families of small and obscure flies, the Borboridæ and Phoridæ. All the material of these families is from the Seychelles Islands proper. There are nine species of Borboridæ, one of which is new, while the others are apparently of very wide distribution, some being identical with European and even with British species, while one is known from the East Indies, from Africa, and from South America. Of the Phoridæ there are twenty species, fourteen of which have not previously been described. The last paper was by Mr. F. V. **Theobald**, on the mosquitoes obtained by the expedition. There are nine kinds of Culicidæ known from the islands, five of them being new to science. One of these new forms was found by Mr. Fryer in Aldabra, and is named after him *Culicelsa fryeri*; the other four were found in the Seychelles, two of them being included in a new genus (Pseudoficalbia). Other species are of very wide distribution, one of them being the almost world-wide *Stegomyia fasciata*, notorious as the carrier of yellow fever. None of the malaria-conveying forms were found in the Seychelles.—F. **Summers**: Coast vegetation of south-west Lancashire.

PARIS.

Academy of Sciences, June 12.—M. Armand Gautier in the chair.—A. **Haller** and Edouard **Bauer**: 2:6-dibenzoyl-2:6-dimethylheptane and αα'-tetramethylpimelic acid. The sodium derivative of a dialkylacetophenone,

$$RR'CNa—CO.C_6H_5,$$

is treated with a dibromide, $Br.(CH_2)_n.Br.$, and the resulting diketones converted into benzene and the amide $NH_2.CO.C(RR').(CH_2)_n.C(RR').CO.NH_2$ by means of sodium amide. An example of this general method has been worked out, in which R and R' are methyl groups, and the bromide $Br.(CH_2)_3Br$.—Pierre **Termier** and Jean **Boussac**: The exotic character of gneiss and granite complex known as the crystalline *massif ligure*, and the separation of the Apennines and the Alps.—M. Zaboudski was elected a correspondant for the section of mechanics in succession to the late M. Sire, and E. Perroncito a correspondant for the section of rural economy in succession to the late M. J. Kühn.—M. **Luizet**: The form of the curve of light of the variable star δ Cepheus obtained from the observations of Argelander. The discontinuity in the curve of luminosity of this star deduced by Argelander from his observations is shown not to exist. A curve is given embodying the results of various observers, and this is without a break. It is shown, moreover, that Argelander's own observations fall on this curve.—Marcel **Riesz**: A method of summation equivalent to the method of arithmetical means.—J. **Le Roux**: Incurvation and flexion in finite deformations.—Louis **Wertenstein**: An extremely absorbable ionising radiation emitted by radium C. Radium C gives off an ionising radiation which is relatively intense, with penetrating power analogous to that of radio-active projections, and slightly deviable by the magnetic field. It is probably the projection of radium D by radium C.—G. **Reboul**: Conductivity accompanying chemical reactions.—Luigi **Giuganino**: The action of terrestrial translation upon the phenomena of light.—G. **Moreau**: The corpuscular ionisation of saline vapours and the recombination of the ions of a flame.—Georges **Meslin**: Circular double refraction in sodium chlorate. The author has constructed a triprism of sodium chlorate similar to the quartz triprism of Fresnel. Sodium chlorate possesses rotatory power, but differs from quartz in having no ordinary double refraction. The expected separation of the green mercury line into two components was clearly proved.—Miroslaw **Kernbaum**: The decomposition of water by metals. A repetition of Traube's experiments on the simultaneous production of hydrogen and hydrogen peroxide by the action of zinc and other metals upon water. The non-production of hydrogen in the absence of dissolved oxygen is confirmed, but, contrary to Traube's results, some hydrogen always appears to be formed.—J. B. **Senderens** and J. **Aboulenc**: The catalytic preparations of fatty esters in the wet way. The addition of potassium bisulphate to an equimolecular mixture of acetic acid and ethyl alcohol causes a marked increase in the amount of ethyl acetate formed in a given time. The use of sulphuric acid in the preparation of esters is discussed from this point of view.—Jean **Nivière**: The action of isobutylamine and di-isobutylamine upon

α-bromobutyric acid. Isobutylamine gives α-isobutylaminobutyric acid; di-isobutylamine gives only α-oxybutyric acid. —G. **Vavon**: The addition of hydrogen to limonene. In presence of platinum black hydrogen is added to limonene in two phases, a dihydride being first formed and a tetrahydride the final product. Some reactions of the dihydride are given.—André **Meyer**: Azomethines derived from phenylisoxazolone.—Ch. **Mauguin**: The orientation of liquid crystals by the magnetic field.—Fernand **Guéguen**: A new organ differentiated from the thallus of Mucor.—A. **Prunet**: Various methods of plant pathology and therapeutics.—Marcel **Dubard**: The classification of Lucumæ with functiform radicle.—L. **Gain**: Two new species of Nostoc from the South American Antarctic region.—Marc **Bridel**: Meliatine, a new glucoside hydrolysable by emulsin extracted from *Menyanthes trifoliata.* —B. **Sauton**: Germination *in vivo* of the spores of *Aspergillus niger* and *A. fumigatus.*—L. **Launoy**: Can the guinea-pig be accustomed to strychnine? The tolerance of the guinea-pig to strychnine can be increased experimentally to a considerable extent.—K. **Landsteiner,** C. **Levaditi,** and C. **Pastia**: Research on the virus contained in the organs of an infant attacked by acute polymyelitis.—M. **Maisonneuve**: The ovarian apparatus of Cochylis.—P. A. **Dangeard**: The fecundation of the ciliated infusoria.—A. **Magnan**: The relation between the ventricle and gizzard in birds.—A. **Desgrez**: The toxicity of two new nitriles and the antitoxic action of sodium hyposulphite towards one of them.—A. **Chauchard** and Mlle. B. **Mazoué**: The action of ultra-violet light upon amylase, invertine, and on a mixture of these two diastases. —A. **Joly**: The existence of limestones with flints (Eocene) in the Zarez Mountains, Algeria.—Raoul **Blanchard**: The glacial deposits at Rives.—Louis **Gentil**: A panorama of the Middle Mlouya (eastern Morocco).

June 19.—M. Armand Gautier in the chair.—J. **Boussinesq**: Simple construction (having recourse only to the two ellipsoids, inverse and direct) for light rays for each of the two systems of plane waves of given direction propagated in a transparent crystal.—C. **Guichard**: Certain triple orthogonal systems deduced from curves several times isotropic.—E. **Vessiot**: The kinematics of continuous media of n dimensions.—J. **Hadamard**: Slow permanent movement of a viscous sphere in a viscous liquid medium.—E. **Delassus**: The material realisation of linkages.—Louis **Roy**: Discontinuities of the first order in the movement of flexible threads.—Jules **Courmont** and Ch. **Nogier**: Progressive diminution of output in the ultra-violet with quartz mercury lamps working at high temperatures. The chemical, physical, and physiological actions of the light from mercury vapour lamps in quartz tubes falls off steadily when they are used at high temperatures. This seems to be due partially to the formation, on the interior surface, of a greyish coating (possibly a silicate of mercury). The lamps should be cooled during use.—Henri **Malosse**: Photometer for the control of the illuminating power of public or private lamps.—A. **Guillet**: A regulator depending on synchronisation.—A. **Leduc**: New method for determining γ, the ratio of the specific heats of vapours.—L. **Decombe**: The heat of Siemens.—C. **Caudrelier**: Frequency of electric oscillations in sparks.—F. **Grenet** and P. **Boulenger**: Porcelain filtering funnels.—J. **Meunier**: Spectra produced by the combustion of hydrocarbons and of various metals. The spectra produced by the combustion of magnesium, zinc, cadmium, nickel, copper, lead, bismuth, and antimony are described.—Georges **Baume** and F. Louis **Perrot**: Melting-point curves for mixtures of gases: systems formed from carbon dioxide and sulphuretted hydrogen with methyl alcohol and methyl ether. Melting-point curves for the systems $(CH_3)_2O—CO_2$,

$CH_3OH—CO_2$, $(CH_3)_2O—H_2S$, and $CH_3OH—H_2S$

were obtained, but only in the case of $(CH_3)_2O—H_2S$ was the existence of an oxonium compound, $(CH_3)_2O+H_2S$, indicated.—Paul **Bary**: Osmotic phenomena in non-conducting media. Experiments on solutions of indiarubber and acetyl-cellulose proved that such colloids are to be considered as solid solvents, and that the permeability, for a given substance of a colloidal membrane, will be proportional to the solubility of that substance in the colloid. —Pierre **Jolibois**: The allotropic modifications and the melting point of arsenic. Grey arsenic is stable at all temperatures up to 850°; arsenic deposited as a mirror is unstable, and changes to grey arsenic at about 280° with production of heat. The melting point of grey arsenic determined by two methods is 850°±10.—Max. **Wunder** and B. **Jeanneret**: The action of syrupy phosphoric acid on various alloys obtained in the electric furnace. Many metals and alloys thus obtained, although very resistent to the action of most reagents, are attacked by hot phosphoric acid of specific gravity 1·75. Silicon, zirconium, ferro-silicon, ferro-titanium, ferro-vanadium, manganese silicide, titanium nitride, nickel boride, and even carborundum are all attacked. If carbon be present it remains wholly or partially undissolved.—Mlle. Pauline **Lucas**: Dehydration of alkyl and benzyl-isobutylphenylcarbinols. Tertiary alcohols are produced by the action of organo-magnesium compounds on trialkyl acetophenones. These on dehydration give hydrocarbons containing a double bond.—L. H. **Phillipe**: Glucodecose and glucodecite.—Jakob **Erikson**: The mildew of mallow (*Puccinia malvacearum*); its nature and phases of development.—Jacques **de Lapparent**: The Permian eruptive rocks of the Pic du Midi d'Ossau.—Paul **Godin**: Variations in the size of the bodies of males during post-fœtal growth.—J. **Le Goff**: Glycosuria and saccharosuria in healthy subjects, following the absorption of saccharose.—V. **Balthazard** and Maurice **Nicloux**: Coefficient of toxicity in poisoning by carbon monoxide.—Mme. Marie **Phisalix**: Effects of the bite of a venomous lizard from Arizona (*Heloderma suspectum*).—F. **Picard**: Some points in the biology of *Conchylis ambiguella* and of *Polychronis botrana.*—P. **Sisley,** Ch. **Porcher,** and L. **Panisset**: The action of micro-organisms on some types of colouring matters.—L. **Cayeux**: The transformations of the *massif* of the Cyclades at the end of the Tertiary and the beginning of the Quaternary epochs.—Maurice **Lugeon**: A local inversion of the slope of the rocky bed of the Rhone, below Bellegarde.—E. A. **Martel**: The exaggerations of glacial theories.

CALCUTTA.

Asiatic Society of Bengal, June 7.—Rai B. A. **Gupte**: Folklore of the origin of the constellation Mrigashirsha. The folklore seems to have been based on the shape of the constellation known as Mriga Nakshatra in India and Orion in the west. It says that on the borders of the southern land there was a hunter who was locked up by his creditors in a Shiva's temple, and had to fast. His creditor was paid out of a subscription raised in the temple, and he was released. He went to *Shikār.* During the night one antelope came to the *Bael* tree on which he was sitting. She spoke to him in the human voice, and was allowed to go on promising that she would return. Another came; she promised return, and was allowed to go. Then came a black buck. He was also allowed to go. Lastly came a doe with young ones. They were members of one united family. They held consultation, and decided that they should all present themselves before the hunter for being killed. But the sun rose, and with it there came a change in the disposition of the hunter, due to the fact that he had to fast and to keep up all the night on the sacred Shivarātra-day, dropping *Bael* leaves on a *lingam.* Shiva's agents came to the spot, took the hunter to Kailás, and sent the antelope family to the Starry Heaven, that is, Nakshatralök, and blessed them, saying that they would form in heaven a constellation which should be known as Mriga Nakshatra. In examining the constellations and the signs of the Zodiac in connection with this story, the author found that the position of Sagittarius the hunter suggests the origin of the Shivapanchāyatan, or five in one, in the four signs of the Zodiac, viz. Taurus the Bull, Gemini the Ugma of Shiva, Cancer his *Gands,* with their chief or *ish* Ganesh, and Leo the Lion. Comparing these signs with the group of Shiva and Pārvati, the resemblance becomes so striking that it would be difficult to call it a coincidence. Shiva and Pārvati therefore have their origin in a myth based on the Zodiac.—W. **Kirkpatrick**: A vocabulary of the Pâsi Boli or Argot of the Kunchandiya Kanjars. Kanjar

is the generic name for a number of Indian tribes of a gypsy character, from Sanskrit kánana chará, in the sense of a wanderer in the jungle. Like the gypsies of Europe, the Kanjar and other wandering tribes of known predatory habits have a secret language or cant of their own. The collection given appears to be chiefly based on Hindi, with certain inflections which are attached to the verbal root implying that there is consistence and character in the cant, and perhaps that some of the inflections are from an old form of language now obsolete in modern colloquial Hindustani. Many of the words, however, seem to have no connection with known languages spoken or written in India, nor with any of the various slang or secret codes of other recognised wandering tribes of Dravidian origin. The Argot of European gypsies known as Romanes or Romni similarly has numerous words identical with modern Hindustani, while its Oriental, if not Indian, origin is generally accepted. The Romanes word for dog is *Jookel* or *Jukal*, while the Kanjar word is *Jhukal*. There are other resemblances and exactly identical words apparently common only to Romanes and Kanjar cant. A bibliography of references to the Kanjar and allied tribes is appended, with a list of various secret codes and slang languages, and also gypsy vocabularies.—Lieut.-Colonel D. C. **Phillott**: Some notes on Urdu grammar.

FORTHCOMING CONGRESSES.

JUNE 28, 29.—Conference on Education and Training of Engineers. London. President: Mr. Alexander Siemens, President of the Institution of Civil Engineers. General Secretary: Dr. J. H. T. Tudsbery.

JULY 18-22.—International Association of Seismology. Manchester. President: Prof. Arthur Schuster, F.R.S.

JULY 25-28.—British Medical Association. Birmingham. President: Sir H. T. Butlin, Bart.

JULY 26-29.—First Universal Races Congress. University of London. President: Lord Weardale. General Secretary: G. Spiller, 63 South Hill Park, Hampstead, London.

JULY 29-AUGUST 5.—Congress of French Geographical Societies. Roubaix. President: Prince Roland Bonaparte.

JULY 30-AUGUST 2.—Annual Meeting of the Swiss Society of Natural Sciences. Soleure. President: Dr. A. Pfaehler. Inquiries to Secretaries: Dr. Küng (German) and Prof. Brönnimann (French).

JULY 31-AUGUST 5.—French Association for the Advancement of Science. Dijon. President: M. Charles Lallemand. Secretary: Dr. Desgrez, 28 Rue Serpente, Paris.

AUGUST.—Centenary of the Foundation of the University of Breslau.

AUGUST 12-18.—First International Congress o Pedology. Brussels. President: M. Alexis Sluys. Secretary: M. Vital Plas, 35 Avenue Paul de Jaer, Brussels.

AUGUST 13-20.—Prehistoric Society of France. Nîmes.

AUGUST 31-SEPTEMBER 6.—British Association. Portsmouth. President: Sir William Ramsay, K.C.B., F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 4-6.—Centenary of the University of Christiania. President of Festival Committee: Prof. Brögger.

SEPTEMBER 9-20.—International Congress of the Applications of Electricity. Turin. President of the Committee of Honour: H.R.H. the Duke of the Abruzzi. Honorary Secretary of the Committee: Signor Guido Semenza, Via S. Paolo 10, Milano International Secretary: Col. R. E. Crompton, C.B., R.E., Crompton Laboratory, Kensington Court, W.

SEPTEMBER 24-30.—International Congress on Tuberculosis. Rome. Address for inquiries: Honorary Secretary of the National Association for the Prevention of Consumption, 20 Hanover Square, W.

OCTOBER 2-7.—Third International Congress of Hygiene. Dresden. General Secretary: Dr. Hopf, Reichsstrasse 4, Dresden.

OCTOBER 15-22.—Tenth International Geographical Congress. Rome. President: Marquis Raffaele Cappelli. General Secretary: Commander Giovanni Roncagli, Italian Geographical Society, Rome.

DECEMBER 27.—American Association for the Advancement of Science. President: Dr. C. E. Bessey, University of Nebraska. Permanent Secretary: Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.

DIARY OF SOCIETIES.

THURSDAY, JUNE 29.

ROYAL SOCIETY, at 4.30.—On a New Method of Estimating the Aperture of Stomata: Francis Darwin, F.R.S., and Miss D. F. M. Pertz.—Memoir on the Theory of the Partitions of Numbers. Part VI. Partitions in Two-dimensional Space, to which is added an Adumbration of the Theory of the Partitions in Three-dimensional Space: Major P. A. MacMahon, F.R.S.—The Kinetic Theory of a Gas constituted of Spherically Symmetrical Molecules: S. Chapman.—Radiation in Explosions of Coal Gas and Air: W. T. David.—The Mechanical Viscosity of Fluids: Dr. T. E. Stanton.—A Silica Standard of Length: Dr. G. W. C. Kaye.—The Properties of Oil Emulsions: R. Ellis.—(1) On a Class of Parametric Integrals and their Application in the Theory of Fourier Series; (2) On a Mode of Generating Fourier Series: Dr. W. H. Young, F.R.S.—Pendulum Clocks and their Errors: A. Mallock, F.R.S.—On Ceratopora, the Type of a New Family of Alcyonaria: Prof. S. J. Hickson, F.R.S.—Note on the Sensibility of the Eye to Variations of Wave Length: Prof. W. Watson, F.R.S.—And other Papers.

FRIDAY, JUNE 30.

PHYSICAL SOCIETY, at 5.—On the Effect of a Narrow Saw-cut in the Edge of a Conducting Strip on the Stream Lines in the Strip and on the Resistance of the Strip: Prof. C. H. Lees, F.R.S.—The Capacity Coefficients of Spherical Electrodes: Dr. A. Russell.—Exhibition of the Benkö Primary Battery: W. R. Cooper.

MONDAY, JULY 3.

ARISTOTELIAN SOCIETY, at 8.—Emotional Experiences of some Higher Mystics: Rev. A. Caldecott.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Dutch New Guinea: Capt. C. G. Rawling, C.I.E.

CONTENTS. PAGE